Evaluation of the Quality of Community Based Integrated Management of Childhood Illness and Reproductive Health Programs in Madagascar

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Table of Contents

EXECUTIVE SUMMARY

Introduction: Madagascar recently scaled up volunteer community health worker (CHV) programs in community-based Integrated Management of Childhood Illness (c-IMCI) and reproductive health and family planning (RH/FP) to provide healthcare to remote and underserved communities.

Methods: A cross-sectional observational evaluation was conducted using a systematic sample of 149 CHVs trained in c-IMCI and 100 CHVs trained in RH/FP services. CHVs were interviewed on demographics, recruitment, training, supervision, commodity supply, and other measures of program functionality. CHVs were tested on knowledge of the case management guidelines or reproductive health and injectable contraception, respectively. Trained experts observed the performance of c-IMCI-trained CHVs as they each evaluated five ill children under 5 years old and RH/FP-trained CHVs as they completed five simulated client encounters with uninstructed female volunteers at a health facility. Each ill child was clinically re-assessed by a trained gold standard evaluator and results were compared to determine if c-IMCI CHVs performed essential assessment, classification and treatment tasks correctly. A c-IMCI CHV performance score (1–100) was calculated based on the mean percentage of tasks performed correctly for each ill child. A key outcome, the proportion of recommended treatments that were prescribed correctly by c-IMCI CHVs compared to the gold standard was determined. RH/FP CHVs were observed by trained experts as they discussed and counseled female clients in family planning options. An RH/FP CHV performance score (0–100) was developed scoring the CHVs' ability to obtain basic information about a clients' contraception needs, determine eligibility for a

method in which clients showed an interest and the quality of counseling provided for the chosen method. Multivariable linear regression models were used to identify factors associated with CHV performance.

Results: c-IMCI CHVs evaluated a total of 745 ill children under 5 years old. Their mean overall performance score was 75.1% (95% confidence interval [CI]: 72.3, 77.8). Higher scores on the knowledge assessment, having more years of education and more CHV responsibilities were associated with better performance, while distance of greater than 20 km from a health facility, 1–5 supervision visits in the previous 12 months, and children presenting with respiratory illness or diarrhea were associated with a lower performance score. When compared to a gold standard evaluator, c-IMCI CHVs referred 68% of children with severe illness or other indications for immediate referral to a health facility, and chose the appropriate life-saving treatment when it was needed only 53% of the time for children presenting with a c-IMCI treatable illness(uncomplicated diarrhea, pneumonia or malaria). CHVs demonstrated good technical proficiency in performing and interpreting RDTs, however CHVs chose to use them when indicated only 55% of the time. RH/FP-trained CHVs had a total of 500 clinical encounters with women to provide family planning counseling. RH/FP-trained CHVs had a mean overall performance score of 73.9 (95% confidence interval [CI]: 70.3, 77.6). More education, more weekly volunteer hours, and receiving refresher training correlated with a higher performance score. For critical tasks, such as promoting informed choice, screening clients for pregnancy and potential medical contraindications to certain methods and providing clients instructions critical to successful method use, RH/FP CHVs had a mean critical task performance score of 78.2% (95% CI: 75.5-80.8%). Nevertheless, RH/CHVs did not always completely follow standard

checklists to rule out pregnancy (complete checklist used in only 69% of client encounters) or to assess contraindications for oral contraceptive use (all necessary questions asked during only 41% of encounters with women expressing interest in the oral contraceptive method).

Conclusions:

CHVs trained in c-IMCI in Madagascar commonly made errors in managing childhood illnesses similar to those reported for integrated community case management programs in other countries. c-IMCI CHVs performed well in identifying and evaluating a child's symptoms, however treatment quality was low. Specific case management skills that require improvement were identified. CHVs demonstrated suboptimal performance in referring children with severe disease and poor performance in classifying and treating children with uncomplicated diarrhea, pneumonia, and fever when compared to a gold standard evaluator. The CHVs trained in RDTs demonstrated good technique in performing and interpreting RDTs correctly but did not always choose to perform one when indicated. Although areas of deficiency were identified, RH/FP-trained CHVs proved capable of providing high-quality contraception services, especially in conducting the most medically critical tasks. Multivariable linear regression analysis identified factors associated with performance, which could be used to tailor and strengthen programs and identify those CHVs needing additional supervision and training. The magnitudes of the associations measured were small and establishing comprehensive monitoring and evaluation plans will be critical to determining which program changes improve service delivery, quality and effective access to care in the future.

ABBREVIATIONS

ACT   Artemisinin-based combination therapy

AC   Agent Communautaire

CDC   US Centers for Disease Control and Prevention

CHV   Community health volunteer

CHW	Community health worker
c-IMCI	Community-based Integrated Management of Childhood Illness
COSAN	Community health committee
CPR	Contraceptive Prevalence Rates
CSB	*Centre de Sante de Base*
DHS	Demographic Health Survey
DSE	*Direction de la Santé de l'Enfant*
DSME	*Direction de la Santé de la Mère*
DPMA	Depot medroxyprogesterone acetate
GFATM	Global Fund for HIV/AIDS, Tuberculosis and Malaria
GOM	Government of Madagascar
HBMF	Home-based management of fever
HF	Health facility
IRB	Institutional Review Board
IMCI	Integrated Management of Childhood Illness
LSMS	Living Standards Measurement Survey
MDG	Millennium Development Goal
MoH	Ministry of Public Health
MUAC	Mid-Upper Arm Circumference
NGO	Non-governmental Organization
NMCP	National Malaria Control Program

NSA	National Strategic Application Grant
ORS	Oral Rehydration Salts
PMI	President's Malaria Initiative
PHC	Primary Care Health Center
PNLP	*Programme National de Lutte Contre le Paludisme*
RDT	Rapid Diagnostic Test
RH/FP	Reproductive Health/ Family Planning
SN2	Santénet2
SPM	*Service de la Prévention de la Malnutrition*
TA	*Technicien d'appui* (Supporting technician)
UNICEF	United Nations Children's Fund
UNFPA	United Nations Population Fund
USAID	United States Agency for International Development
WHO	World Health Organization

BACKGROUND

Access to high quality preventive and curative services is essential for reducing child and maternal mortality.[1] Scaling up training and deployment of Community Health Workers (CHWs) to provide specific health services has been identified as an important strategy to achieve the Millennium Development Goals (MDGs) in resource-poor settings with shortages of health resources and poor access to health care.[2]

Health service utilization in Madagascar is low. The most recent Living Standards Measurement Survey (LSMS) in Madagascar estimated health service use among ill persons to be only 32% and has remained unchanged over the past several years. [3-5] Cost and distance to health services were cited among the top three reasons ill persons did not seek care at a health facility. Among ill children under five years old included in the 2008–9 Demographic and Health Survey (DHS), those with fever, diarrhea, or an acute respiratory infection, only 41%, 34%, and 42%, respectively, sought care from a health facility.[6] In the same survey, 57% of women living in rural areas that were interviewed reported distance to the nearest health facility as a major barrier to seeking care.[6]

Madagascar is committed to reaching the MGDs, including reducing child mortality, improving maternal health, and in part, by realizing universal access to reproductive health.[7, 8] There is a strong tradition of Community Health Volunteers (CHVs) or *Agents Communautaires* (AC), a cadre of volunteer CHWs who do not receive regular pay for their services. CHVs are considered by the Government of Madagascar (GOM) and several partners as one of the most important ways to reach its predominantly rural population and thus potentially an important

resource for expanding health services. In 2009, Madagascar's Ministry of Public Health (MoH) published a National Community Health Policy and implementation guide to promote and harmonize community-based health services by taking stock of and using lessons learned from multiple smaller-scale, vertical community-based health initiatives in Madagascar.[9, 10]

In Madagascar, CHVs have been trained to promote child and maternal health, to provide case management services to children under five years of age using the Community-based Integrated Management of Childhood Illness (c-IMCI) model, and to provide reproductive health counseling and family planning (RH/FP) services including administration of oral and injectable contraceptives to women of reproductive age. Evaluating the quality of services provided has been identified as a priority as the current program has been rapidly scaled-up and further expansion nationwide is on-going.

Community-based Integrated Management of Childhood Illness

The Integrated Management of Childhood Illness (IMCI) was first launched by WHO and UNICEF in 1992 to address the five major causes of child mortality – diarrhea, pneumonia, malaria, measles and malnutrition.[11] IMCI guidelines were developed to standardize care in health facilities for the major causes of child mortality.[11] In 1997, Community IMCI (c-IMCI) was added as the third component of a comprehensive IMCI strategy. The objectives of c-IMCI are to ensure survival, reduce morbidity, and promote healthy growth and development among children under five years old. c-IMCI consists of three programmatic elements: (1) improving partnerships between health facilities and the communities they serve; (2) increasing appropriate and accessible care and information from community-based providers; and (3)

integrated promotion of key family practices critical for child health and nutrition.[12] The second and third c-IMCI elements focus on the promotion of 16 key health practices within the household and community[13] including appropriate home care and care-seeking behavior for common childhood illnesses such as diarrhea, acute respiratory illness, and malaria.

In Madagascar, the mortality of children under five years of age remains relatively high at 72 per 1,000 live births[6]. In addition, 75% of the population lives in rural areas[14] and nearly half of the rural population of Madagascar falls within the two poorest quintiles, which experience under five mortality rates of over 90 per 1,000 live births[15]. Most of these deaths are attributed to preventable or easily treatable diseases, including malaria, malnutrition, diarrheal disease and severe respiratory infections.[16]

As an early step to expand basic health services to children under 5 years old, presumptive home-based management of fever (HBMF) with chloroquine treatment was first introduced in Madagascar in 2003 through CHVs. The National Malaria Control Program (NMCP) updated its case management policy in 2005, adopting artemisinin combination therapy (ACT) in the setting of high chloroquine drug resistance and began requiring biologic confirmation of all cases. The national first-line antimalarial is artesunate-amiodiaquine (AS/AQ) which was introduced at the community level in late 2008. The use of rapid diagnostic tests for malaria (RDTs) by CHVs began in 2010. Over the same period, HBMF was modified and integrated into a standard c-IMCI model. In 2007, UNICEF sponsored the introduction of the c-IMCI model in close collaboration with and implemented by the public health system. Starting in 2008, USAID supported further expansion and scale-up of integrated case management,

using the same c-IMCI model, through a network of non-governmental organizations (NGOs) managed by the USAID/Santénet2 (SN2) project, which covers 800 communes and about half the rural population of Madagascar. By February 2011, with the combined help of several health development partners, approximately 4800 CHVs had been trained in c-IMCI, including the case management of diarrhea, respiratory infections, and fever.

Substantial funding for further scaling up c-IMCI nationwide became available through the Malaria National Strategic Application (NSA) Grant of the Global Fund for HIV/AIDS, TB and Malaria (GFATM) in late 2010. National plans were developed to train or re-train 34,000 c-IMCI CHVs to work in over 17,000 fokontany in Madagascar by the end of 2012. Early NSA-supported activities included updating and standardizing the national c-IMCI curriculum, reporting and developing supervision tools.

We included both USAID/NGO supported and MoH/UNICEF supported c-IMCI CHVs who had been trained prior to March 2011 in order to assess the quality of care provided prior to implementing a nation-wide scale up.

Community-based Reproductive Health Services

In Madagascar, universal access to reproductive health counseling is also a priority. Madagascar has experienced a dramatic decline in fertility from about 7.3 total births per woman in the 1970s to 4.8 in 2008–2009.[14] Fertility is higher among rural women than urban women (5.2 and 2.9, respectively) and is inversely related to education. A substantial increase in contraception use, especially injectable contraception, has driven the overall decrease in fertility in Madagascar.[17] About 29% of women reported current use of a modern

contraceptive method in 2008–2009 with injectables being the most commonly used method (18%) followed by oral contraception (6.0%).[14] Few women reported using implants (2%) or male condoms (1%).[14]

Despite these successes, Madagascar is still facing rapid population growth. Madagascar's population in 2012 is estimated at 21.7 million [18] and is expected to reach 42.3 million by 2050. The population is very young, with 44% under 15 years of age.[19] There are still urban (36%) and rural (28%) discrepancies in modern contraceptive prevalence rates (CPR) with wide regional variations.[15] For example, in the Androy region, only 3% of women who are sexually active utilize a modern method of contraception. CPR also varies significantly across wealth quintiles. Only 17.6% of the poorest Malagasy use modern methods compared with 36.4% of the richest.[15]

To date, Madagascar's family planning efforts have depended heavily on financing from donors (UNFPA, USAID, and World Bank), which altogether accounted for 99% of spending for contraceptives from 2004 – 2008. The Malagasy government allocated funds to purchase contraceptives for the first time in 2006; this was discontinued in 2009 because of lack of funds.

USAID programs have supported training CHVs who offer reproductive health counseling and a variety of family planning options including injectable contraceptives, one of the most popular types of contraceptive methods.[20] CHVs were first trained to administer Depo-Provera in November 2006 as part of a pilot project.[21] An evaluation of the pilot showed CHVs were able to perform counseling and administration of injectable contraceptives and maintain quality standards with the potential to reduce the unmet need for contraception in

their communities. The MoH subsequently decided to promote and expand community-based distribution of injectable contraceptives to sites with high functioning CHV programs.[21] With USAID support, communities have scaled up the program and have established an expansive network of over 4000 RH/FP CHVs trained to provide community-based service as of February 2011. To date, there has been no independent evaluation of the quality of services after the expansion. These services are being further expanded to an additional 200–300 communes in Madagascar through a USAID-funded community health project that began in 2011. Given the rapid scale-up and planned expansion, an evaluation of CHVs skilled in maternal and reproductive health promotion and provision of RH/FP services was included as part of this evaluation.

We assessed the quality of services provided among CHVs trained in c-IMCI and RH/FP in Madagascar in order to identify strengths and deficiencies in the program given the scale up in progress and to identify factors associated with performance. Specifically, we investigated CHVs' adherence to guidelines for treating ill children and counseling women in RH/FP choices, evaluated CHVs' readiness to evaluate patients in terms of knowledge and supplies, identified barriers to effective implementation of services and factors associated with poor performance, and characterized the volume of patients evaluated by CHVs to indirectly measure utilization.

METHODS

<u>Study design and population</u>

A cross-sectional survey of a systematic sample of 150 CHVs trained to provide c-IMCI (c-IMCI CHVs) and 100 CHVs trained to provide RH/FP (RH/FP CHVs) services in Madagascar was

conducted. Field data were collected over a 3 week period in September–October, 2011. Note that this season falls outside the peak season for malaria in Madagascar.

<u>Sample size</u>

The sample size estimate was calculated conservatively assuming that c-IMCI CHVS correctly prescribe recommended treatments at least 60% of the time. A minimum sample size of 688 patient encounters was calculated with a 5% margin of error (80% power, alpha of 5%, design effect of 2).

<u>Sample selection</u>

The sampling frame included all SN2 supported or MOH/UNICEF supported CHVs that had been trained in c-IMCI at least 6 months prior to the survey and had demonstrated functionality defined as having reported treating ill children or providing FP services. To select CHVs to participate in the survey, multi-stage sampling was used. A list of districts with active CHVs was compiled: a total of eight districts with MoH-trained CHVs supported by UNICEF and 64 districts with CHVs supported by the SN2 program. Districts were stratified by funding support (UNICEF and USAID) and regrouped so that districts or district-groups contained a minimum of 15 c-IMCI CHVs in UNICEF sponsored areas or 15 CHVs of each type, c-IMCI and RH/FP, in SN2 coverage areas. If a district had less than the required 15 CHVs, they were grouped geographically to create a final list of "district-groups" including either a 1-district or 2-district area that contained at least 15 CHVs.

The eight districts with UNICEF sponsored/MoH supported CHVs were ordered from North to South and five were selected by systematic probability sampling with a computer

generated random starting point. There were 64 districts with SN2 supported CHVs; however, 11 districts had less than the required 15 CHVs and were grouped geographically to establish 53 total district-groups for the sampling frame. The 53 SN2-supported district-groups were ordered North to South and 10 were selected by systematic probability sampling with a computer generated random starting point. After the 10 district-groups were selected, "commune groups" were created within each district-group containing at least 15 c-IMCI CHVs and in the SN2 areas also at least 15 RH/FP CHVs. One commune group was randomly selected in each of the 10 districts-groups. Among each of the 10 selected commune groups with SN2 supported CHVs, 15 c-IMCI CHVs and 15 RH/FP CHVs were randomly selected and among each of the 5 commune groups with UNICEF sponsored MoH-trained CHVs, 15 c-IMCI CHVs were selected. A total probability sample of 225 c-IMCI CHVs and 150 RH/FP CHVs (to ensure a minimum of 688 ill child encounters and approximately 500 female FP client encounters), was selected and included over-sampling by 50% to account for anticipated field challenges including the likelihood that some selected CHVs would be unavailable at the time of data collection.

Data collection

Selected CHVs were asked to travel to the nearest *Centre de Santé de Base* (CSB) or primary care health center (PHC) with an adequate volume of patients (enabling at least five assessments of children and five client encounters with women of reproductive age on a given day) in proximity to their community-based sites. We observed five encounters between the selected c-IMCI CHVs and ill children under five years of age or selected RH/FP CHVs and women of reproductive age arriving for consultation at the PHC in order to assess CHV

performance. Expert observers and gold standard evaluators were recruited from an existing c-IMCI and RH/FP trainer and supervisor pool used by the large network of NGO partners that implement community-based programs in Madagascar. Evaluation personnel were re-trained for this evaluation. Prior to field work, evaluators practiced interviews, direct observation and clinical re-examination using role-plays. Evaluators were required to demonstrate proficiency in scoring the patient encounters in a standard manner before beginning data collection. Expert observers and gold standard evaluators were assigned to district sites outside of their usual geographic coverage area to minimize the likelihood that they would have had pre-existing relationships with the selected CHVs.

Evaluation components

CHV Questionnaire

The day before the observed clinical encounters, a standardized questionnaire was administered to each CHV. CHVs were asked questions to determine their demographics, individual characteristics, and self-reported measures of their program- site functionality based on a list of essential components for CHV programs.[22, 23] These components address program functionality, from the CHV's viewpoint, related to recruitment, CHV role, initial training, continuing training, equipment and supplies, supervision, individual performance evaluation, incentives, community involvement, referral systems, opportunities for advancement, documentation and information management linkages to the health system, program performance evaluation and country ownership. We included questions related to each

component except for the final three which are system level and could not be measured for individual CHVs. CHVs were also asked about their typical patient load and number of patients visits they had in the month and week prior to the survey.

Knowledge Assessment

For CHVs trained in c-IMCI, a knowledge assessment, including eight open-ended questions (responses were not prompted) about c-IMCI algorithm components and clinical scenarios, was administered. An additional 4 knowledge questions on the use of RDTs were administered to those c-IMCI-CHVs who reported having received training in RDT use. A separate knowledge assessment, including 10 open-ended questions related to assessing client eligibility for and administration of depot medroxyprogesterone acetate (DMPA) contraceptives was administered to the RH/FP-trained CHVs.

c-IMCI CHV observation and gold standard comparison

The c-IMCI CHVs were observed performing evaluations of five ill-children at the PHC. Expert observers from the study team scored the encounters using a standard observation checklist. Acutely-ill children who were waiting for an initial clinical consultation were recruited and voluntary written informed consent was obtained from their caretaker prior to their participation. Children with obvious immediate life-threatening illnesses were not recruited, as inclusion in the evaluation would interfere with timely care and treatment. We evaluated the CHVs' ability to assess (including identifying danger signs), classify, treat or refer appropriately as required by c-IMCI guidelines in Madagascar (see Appendix Figures A1-A4). The same ill-children were examined a second time by a trained gold standard evaluator from the survey

team who was blind to the outcome from the clinical evaluation by the CHV and the results were recorded. The gold standard evaluation was used as an independent determination of the child's IMCI illness classification for later comparison. Participating patients did not receive treatment directly from CHVs or gold standard evaluators; however gold standard evaluators communicated any pertinent information, such as RDT test results, to the health providers at the PHC as appropriate.

RH/FP CHV Observation

The RH/FP CHVs each completed five female client encounters to demonstrate contraceptive counseling and assess client eligibility for different chosen family planning methods. Female patients, 15–49 years of age, who were waiting for a clinical consultation (either for themselves or a family member) for a non-emergency condition were recruited, and voluntary written informed consent obtained before participating in the encounters. Because the typical volume of women seeking a new contraceptive method per day at sites was observed to be too low to achieve the predetermined sample size, all encounters were simulated in that CHVs asked participants about their contraceptive needs and medical history as though the participants were seeking a new method. Participating clients did not receive contraceptive methods as part of this study; rather, those expressing interest for a specific method were referred to a professional health provider at the same site for subsequent service delivery. Expert observers scored the encounters using a standard observation checklist, consisting of two parts: 1) Part 1 assessed the CHV's procedures used in welcoming the client and obtaining basic information about her contraception needs and 2) Part 2 assessed the

CHV's ability to determine the client's eligibility for a method in which she showed an interest and the quality of counseling provided on that method.

Inclusion criteria

c-IMCI

CHVs who had been conducting c-IMCI for at least six months and were trained by MoH/UNICEF or SN2 were eligible to participate in the evaluation. Those children under five years old presenting to the HF for initial acute illness consultation (the first time the patient had been to the facility for the illness episode), and children and their caretakers who gave voluntary informed consent, were included in the evaluation.

RH/FP

CHVs trained in RH/FP and had been providing RH/FP services for at least six months and were trained by SN2 were eligible to participate in the evaluation. Those women 15-49 years old presenting to the HF for consultation for themselves or their family members and who gave voluntary informed consent were included in the evaluation.

Exclusion criteria

c-IMCI

Exclusion criteria for children participating in the study were as follows: those who refused or were unable to provide informed consent, older than five years, those children with evidence of immediate life-threatening illnesses where participation in the evaluation would interfere with timely or appropriate medical care, those presenting for a non-acute illness

reason, such as routine vaccinations. CHVs with less than six months of experience in c-IMCI and those with formal healthcare training outside of c-IMCI were excluded from the evaluation.

RH/FP

Exclusion criteria for the women included in the evaluation were as follows: those who refused or were unable to provide informed consent, those women younger than 15 years and older than 49 years, and those women with danger signs or other evidence of severe illness where participation in the evaluation would interfere with provision of appropriate or timely medical care. CHVs with less than six months of experience in RH/FP and those with formal healthcare training outside of RH/FP were also excluded from the evaluation.

Definitions of primary outcomes

c-IMCI

Primary outcomes were assessed in terms of an overall performance or adherence score. The performance score was defined as the percentage of key assessment, classification and treatment tasks performed correctly for each child by the CHVs compared to the gold standard evaluators. The correct assessment, classification and treatment for each child were established by the gold standard evaluator trained in national c-IMCI guidelines. The performance score was a continuous variable ranging from 0% to 100% and included a maximum of 23 of equally weighted procedures: 15 assessment tasks, four classification tasks, and four treatment tasks (Table 1). CHV treatment quality outcomes were measured by assessing if the CHV correctly chose life-saving or essential treatments compared to the gold standard. Life-saving or essential treatments were any of the following which were considered

as the minimum adequate treatment for potentially life-threatening illness: referral to the nearest health facility for any severe illness, antimalarials for uncomplicated (RDT positive) malaria, antibiotics for uncomplicated pneumonia, oral rehydration salts (ORS) and zinc for uncomplicated diarrheal illness. The first-line oral antimalarial was ACT AS/AQ, the first-line oral antibiotic for the treatment of uncomplicated pneumonia was cotrimoxazole and the first-line treatment for uncomplicated diarrhea was ORS and zinc (see Table 2). Treatment quality was categorized as 1) recommended treatment exactly matched c-IMCI guidelines and 2) life-saving/adequate treatment (not the full recommended treatment but the minimum to be considered potentially life-saving). In this report, we report results in terms of correct treatment defined as life-saving/adequate treatment.

Performing an RDT is one of the more complex c-IMCI CHV diagnostic tasks. For all children requiring an RDT, expert observers used a detailed RDT checklist which we analyzed to describe the CHV's ability to perform individual RDTs tasks correctly.

RH/FP

Primary outcomes were assessed in terms of an overall performance or adherence score. The performance score for each client was calculated to assess adherence to guidelines, defined as the percentage of all guideline recommended tasks and procedures that were performed correctly during the client encounter. The score was a continuous variable ranging from 0 to 100% and included a maximum of 26 equally weighted tasks: Part I counseling tasks, Part II client eligibility assessment tasks (see Table 3).

<u>Statistical Analyses</u>

Data analysis was performed using Statistical Analysis Software (SAS) v. 9.2 (SAS Institute Inc.; Cary, NC). Descriptive statistics of the included CHVs, children and women were determined. Outcomes were adjusted for sampling weights of the CHVs and repeated measures as each CHV assessed five patients/clients.

c-IMCI Analysis

We created a performance score to represent the overall performance of CHVs. The score includes 23 possible tasks. Not all clinical encounters with ill children required all 23 tasks (Table 1).

The components of the score are as follows: assessment of nutrition status using mid-upper arm circumference (MUAC), identification of the chief complaint, assessment of symptoms associated with chief complaint, ascertainment of the correct classification, and choice of the correct treatment. Correct completion of each task earned one point, with the exception of those tasks associated with the assessment of individual chief complaints. These were weighted so that their additive weight equaled to one point. For example, there were two assessment tasks associated with evaluating and classifying cough symptoms, 1) the presence or absence of costal retractions and 2) determining the respiratory rate, so each of these tasks was worth 0.5 points.

The performance score represents overall performance of the CHV taking into account multiple key aspects of the clinical encounter. This score was used as the outcome indicator in a multivariable linear regression model to identify factors associated with performance. We

performed univariate analysis to identify CHV characteristics, child characteristics, knowledge score, components related to the functionality of the CHV program and other variables as potential correlates of the CHV performance scores. We then developed a multivariable linear regression model by first fitting a full model including all potential correlates with a p-value of <0.1 in the univariate analysis and then, in a backwards stepwise progression manually removed variables that were not associated with performance scores at the alpha 0.05 level.

RH/FP Analysis

We calculated weighted binomial or multinomial proportions with 95% Wilson (score) confidence intervals (CIs) for the components related to the functionality of the CHV program and responses on the test of depot medroxyprogesterone acetate (DPMA) knowledge.[24] We calculated a performance score (0–100%) for each CHV by averaging their mean scores on Part 1 and 2 (weighted equally) of their five client encounters.

We used multivariable linear regression to assess the variables on demographic and other characteristics and the components on the functionality of the CHV program as potential correlates of the CHV performance scores. We fit a full model with all potential correlates and then, in a backward stepwise progression, manually removed variables that were not associated with performance scores at the alpha 0.05 level. We tested for heteroscedasticity and dependence of error and used the Shapiro-Wilk test to ensure that the error terms originated from a normal distribution. We used the Variance Inflation Factor statistic (with a cut-off of 10) to confirm the absence of multicollinearity.

RESULTS

Overall, 249 CHVs from 16 districts in Madagascar were evaluated (Table 4). The 149 c-IMCI-trained CHVs evaluated five ill children each, for a total of 745 evaluations. The 100 RH/FP-trained CHVs performed five simulated patient encounters with women presenting to the health facility, for a total of 500 encounters. During field data collection, 20 substitutions were made among the 249 CHVs assessed; 14 of the 149 c-IMCI-trained CHVs and six of the 100 RH/FP-trained CHVs. Substitutions were made because more CHVs were unavailable at the time of the evaluation than anticipated because they had temporarily moved for work, permanently moved for work, were ill or had died, resigned or were too busy to travel to the CSB for the evaluation. The 20 CHV substitutions were made with CHVs identified from the same selected commune-groups and were thought to be sufficiently similar to be included in the evaluation (met inclusion criteria). The location of selected district-group sites are summarized in Table 4 and shown in Figure 1.

CHV demographics

The demographic characteristics of CHVs, stratified by type are shown in Table 5. CHVs interviewed and observed were evenly divided by gender. Participants had a mean age of 42 years (95% CI: 40.3, 43.9) and 40 years (95% CI: 38.3, 42.2) for c-IMCI and RH/FP CHVs, respectively. The proportion of c-IMCI and RH/FP CHVs more than 45 years old, the suggested age limit per national guidelines[10], were 35% and 34% respectively. CHVs had completed a mean of seven years of education. Only 6% of c-IMCI CHVs reported having fewer than 5 years of formal education, the minimum program requirement; however 34% of RH/FP CHVs

reported less than 5 years of education. c-IMCI CHVs had a mean of 32 months of experience as a CHV and RH/FP CHVs had a mean of 26 months of experience.

The mean distance of the CHVs' site from the nearest PHC was 10–11km and based on CHV self-report, only 16% of CHVs worked at sites less than 5km from the nearest PHC. Few (<13%) c-IMCI CHVs reported prior healthcare experience. Only 10.2% c-IMCI and 7.9% RH/FP CHVs self-identified as community health supply distributers. CHVs spent a mean of 11 hours per week working as a health volunteer.

CHV Program Functionality

CHVs were asked several questions to describe different components of their program classically related to functionality[23] and results are summarized in Tables 6–13.

Recruitment

Most CHVs (>80%) reported being recruited by their communities with over one fourth reporting that the Fokontany chief was involved but few (<5%) cited the Community Health Committee (CoSan) as having a role in their recruitment (Table 6). All CHVs reported working in the same village in which they resided as required per program guidelines.

CHV Role and Responsibilities

A very high proportion of c-IMCI and RH/FP CHVs reported that they were aware of their role and responsibilities (94% and 89% respectively) and an even higher percentage (99 and 100% respectively) reported they owned a written description (Table 6). Over half of the CHVs reported that the Chef CSB (58% of c-IMCI CHVs and 59% of RH/FP CHVs) also had written

copies of their role description; however, only 5-8% of Chef Fokontany were reported to have copies. Very few CHVs (<5%) reported that the Community Health Committee or *CoSAN* had written copies. Among the 149 c-IMCI CHVs, 126 (85%) had received training to use RDTs for diagnosing malaria. Many CHVs reported covering additional responsibilities: over 90% of both types of CHVs reported counseling community members on safe water, good sanitation and hygiene and over two-thirds sold point of use water treatment kits; 71% of c-IMCI CHVs administered DOT for tuberculosis in their communities; over two-thirds of both types reported administering Vitamin A to children during bi-annual mother and child health weeks. Among RH/FP CHVs, 18% reported giving folic acid to pregnant women in their communities.

Training

All CHVs reported receiving initial training for their main role (Table 7). Three c-IMCI CHVs were also cross-trained in reproductive health and family planning. Most CHVs reported receiving initial training from NGOs (85% of c-IMCI and and 98% of RH/FP CHVs). Only about one fourth had been trained as a CHV by both an NGO and the health staff from their PHC (*Chef CSB*) (data not shown). Only 54% of c-IMCI and 31% of RH/FP CHVs said they had ever received refresher training. Among these, the mean time to the last refresher training was 8.1 months at the time of the survey and lasted an average of 3–5 days depending on the type. Importantly, seventy-eight percent of c-IMCI CHVs said that they felt comfortable implementing c-IMCI after their initial training. Eighty-eight percent of RH/FP CHVs felt capable of providing FP services after their initial training but only 58% said they felt comfortable administering DEPO injections initially. About half of all CHVs said that they had received some training in management and planning.

Supervision

Most CHVs said they had been supervised at least once in the previous 12 months, with 69% of c-IMCI CHVs and 75% of RH/FP CHVs reporting they received a technical supervision visit at least once a quarter (Table 8). Only 21% of c-IMCI and 13% of RH/FP reported that they had never receive regular technical supervision visits. Among CHVs that had been supervised, more than 80% reported the following activities were conducted by their supervisor: a review of individual patient forms, registers, monthly reports, discussion of problems, provision of feedback to the CHV and assistance in resolving problems. Importantly, over 95% of CHVs reported the supervisor checked their monthly report or register during the technical visit. Approximately half of all CHVs reported being observed by a supervisor while providing services at their PHC and 55% of c-IMCI CHVs and 30% of RH/FP CHVs had been observed examining a child or conducting an FP session, respectively, at their sites. Only half of all CHVs reported ever receiving a formal evaluation. Activities that were part of the formal evaluation are listed in Table 8.

Volume of patients

The c-IMCI CHVs reported seeing a mean number of four children in the month preceding the evaluation (95% CI: 3.3, 5.3) (Table 9). RH/FP CHVs saw a mean number of 10.9 clients in the month preceding the survey. During the 3 months preceding the survey RH/FP CHVs delivered services to a mean number of 9.4 clients using OCPs and 15.0 clients using DMPA. Clients very rarely requested condoms.

Perceived motivational factors and challenges

The most commonly reported advantages by CHVs were: per diem for training (90% among c-IMCI and 97% among RH/FP CHVs), training and orientation (78% and 89% respectively) (Table 10). RH/FP CHVs more often cited feedback (90%) and support (91%) as advantages compared to c-IMCI CHVs (only 76% reporting feedback and 74% reporting support). Over two-thirds of CHVs felt there were opportunities for advancement and when asked what type, CHVs most frequently cited training workshops (>80%) and learning new technical skills (>78%). Although CHVs in Madagascar are volunteers, 6% of c-IMCI CHVs reported receiving regular monetary income for their work as a motivating factor. CHVs most commonly cited official recognition and community support as the advantage or motivation they received from their respective communities. Almost all CHVs agreed that they felt happy to be able to help their community in their role as a CHV. When asked about the biggest challenges they faced 38% of c-IMCI CHVs cited making a correct illness classification and 36% cited determining the appropriate treatment to dispense. Approximately 1 in 6 CHVs reported having enough time to see clients or patients and scheduling conflicts with their regular work as important challenges. Some CHVs reported other general challenges ("other challenges" in Table 10, individual responses not shown) including: needing more education or experience, improving the health of their communities, being able to perfecting their ability to provide services, lack of a physical place/building to provide services, and lack of opportunities for advancement.

Supplies and Equipment

CHVs require an adequate supply of forms, diagnostic instruments, and medications to perform their duties. One-third of CHVs reported they did not have adequate supplies to

perform their job at the time of the survey (Table 11). The majority of CHVs had experienced a

stock-out of medications or supplies; 67% of c-IMCI CHVs and 70% of RH/FP CHVs. Among

those experiencing a shortage: the mean number of stock outs of essential supplies in the past

6 months was 1.4 times (95% CI: 1.2, 1.6) among c-IMCI CHVs and 1.8 times (95% CI: 1.5-2.1)

among RH/FP CHVs. Among the c-IMCI CHVs who had had a stock-out, 20-25% reported being

stocked out of ACTs and/or cotrimoxazole and/or ORS and only 6% had had a stock out of RDTs.

Stock-outs of contraceptives were slightly lower in comparison with only 21% of RH/FP CHVs

reporting a stock-out of OCPs and 15% reporting stock-outs of DPMA. Half of all stock outs

lasted more than one month and over 20% of stock-outs lasted for >3 months. Importantly,

more than half of c-IMCI CHVs and one third of RH/FP CHVs cited stock-outs as the biggest

challenge they faced in their work and cited needing a regular stock of medicines and supplies

to improve how they function (Table 10). To resolve stock-outs, most CHVs requested supplies

from the nearest CSB or the NGO support technician (*technician d'appi* or TA).

Record Keeping and Forms

Almost all (>95%) of CHVs said they filled out monthly reports for the PHC and staff

(Table 12). Approximately half of CHVs shared reports monthly with community members.

Most CHVs had referred patients to the PHC when needed and filled out a referral form.

Among CHVs who had referred at least one patient to a PHC, 57% of c-IMCI CHVs reported

always receiving counter-referral forms from the PHCs and less than half of RH/FP CHVs (46%)

reported always receiving counter-referral information. Twenty-four percent of referring c-IMCI

CHVs and 39% of RH/FP referring CHVs said they never received counter-referral information.

The most commonly cited method of transporting referred patients to the PHC was by foot (cited by 83% of c-IMCI CHVs and 69% of RH/FP CHVs) (Table 13).

Knowledge assessment

c-IMCI

The knowledge assessment score was based on the number of correct answers divided by the total number of applicable questions, either 8 or 12, depending on whether the CHV was trained in administering RDTs as described above (Table 14). The average score on the knowledge assessment was 85% both among CHVs not trained in RDTs (answering 8 core questions) and among those trained in RDTs (answering 8 core questions plus 4 RDT related questions) (Figure 2). The weakest performance was on questions related to the classification of malnutrition (61% correct), the recognition and management of a non-diagnostic or invalid RDT result (68% correct), treating an uncomplicated fever with a positive RDT result (76% correct) and the classification and treatment of pneumonia (78% correct). CHVs performed best when asked how to treat children presenting with a fever with danger signs (99% correct); describe the respiratory rate criteria for tachypnea in a 3 year old child (92% correct); and when asked to name three danger signs (91% correct).

RH/FP

When tested on their knowledge related to DMPA, 93% of the CHVs knew not to give DPMA to non-menstruating women who were attending an initial, family planning visit; 91% could correctly describe the procedures to follow in case the needle were to hit a blood vessel when administering DMPA; and 98% knew that DMPA is effective for 12 weeks and requires a

repeat injection within 16 weeks (Table 15 and Figure 3). Seventy-seven percent of CHVs were able to list two conditions to exclude pregnancy among non-menstruating women, 67% were able to list four disadvantages or side effects of DMPA and 57% knew to refer clients returning too late for a repeat injection to a health center to avoid an unwanted pregnancy. Overall, CHVs gave a mean of 7.3 (95% CI: 7.0, 7.7) correct responses to the nine questions on DPMA knowledge.

Ill-child demographics

The median age of the 745 children evaluated by CHVs was 13 months (range 1–59 months) and 52% of the children were female (Table 16). Sixty-four percent of the children presented with a chief complaint of cough, 37% with a chief complaint of fever, and 25% with a chief complaint of diarrhea. Seventeen percent of the children presented with a non-cIMCI complaint, beyond the treatment capacity of the CHV, such as a rash, abdominal pain, wound or hematuria, and required referral to a health facility. According to the gold standard, 22% percent of the children presented with an illness with danger signs and 38% required life-saving treatment with ACT, cotrimoxazole, or ORS.

Accuracy of classification and treatment

The primary outcomes for this evaluation were the proportion of children diagnosed correctly based on the gold standard classification and the proportion of children treated correctly based on the gold standard treatment (Tables 17 and 18). The illness classifications assigned by the CHVs were consistent with those of the gold standard evaluator varied from 26-83% depending on the illness (Table 17). CHV performance was best when classifying the

children's nutrition status (86%, n=745) and children with danger signs (73%, n=160) and poorest for classifying severe febrile illness (although there were few cases, 26%, n=6) and uncomplicated pneumonia (39%, n=101). The correct treatment was chosen for 68% of children needing immediate referral and 53% of children for uncomplicated illness (pneumonia, diarrhea and malaria) requiring on-site treatment per c-IMCI guidelines (Table 18). They performed poorly (correct <50% of the time) for the treatment of simple cough, uncomplicated diarrhea and uncomplicated pneumonia.

Performance score and predictive factors

c-IMCI

An assessment score was created for each clinical encounter in order to accurately reflect overall performance was used in the linear regression model to evaluate possible predictors of performance. The mean score was 75% (95% CI: 72, 78) and the median score was 79%, range 6.25%–100% (Table 19). The distribution of performance scores among the CHVs is shown in Figure 4. The CHVs performed best on tasks related to identifying the chief complaint and assessing symptoms related to the chief complaint however they performed sub-optimally on correctly classifying diseases and choosing the correct treatment (Figures 5a–5e).

There are several factors that could potentially be associated with CHV performance and Table 20 lists the main CHV-related and child related factors that were analyzed using a multivariable linear regression model. We found that a higher score on the knowledge assessment, greater number of years of education, and a greater number of perceived responsibilities were predictors of better CHV performance, although the magnitude of the

association was small. Distance from HF of greater than 20km, having 1–5 supervision visits in the past 12 months, and children with respiratory complaints and diarrhea were associated with a lower performance score (Table 20).

Classifying fever and RDT use: Among CHVs that were trained in RDT use (n=126), CHVs correctly chose to use RDTs in only 55% of the clinical encounters where indicated in children with fever (Figure 6). However, among the cases where CHVs correctly chose to use an RDT, CHVs obtained the same RDT result as the gold standard evaluator in 90% of children and chose the correct treatment in 88% of these clinical encounters. Each time a CHV used an RDT, individual RDT tasks were observed and scored as complete or incomplete (Figure 7). RDT tasks were categorized as either hygiene tasks (for example washing hands, using a sterile lancet, etc.) or technical tasks that could influence the accuracy of the reading such as verifying the RDT kit was not expired and collecting an adequate amount of blood. Figure 7 summarizes the performance of hygiene and technical tasks. CHVs performed very well on the technical tasks (92% correct) and moderately well on hygiene tasks (68% correct).

Classifying cough: Among the 328 children with cough, CHVs correctly classified respiratory rate as either (normal or abnormal/rapid) in 60% of cases. Only 20 children had costal retractions and CHVs correctly detected 13 of them, having missed the key clinical signs in 7 cases.

Inappropriate antibiotic and antimalarial use: Among children with respiratory symptoms in the absence of clinical pneumonia, 83 (38%) would have been given antibiotics inappropriately per the CHV treatment decision. However, inappropriate antimalarial use was

rare, CHVs chose to treat 13 (6.8%) of febrile children with ACTs among those with fever and a missing or negative RDT.

RH/FP

Each of the 100 CHVs was scored by an expert observer during the five client encounters (Table 21). The CHVs helped the client express their needs in 78% of the 500 encounters, and encouraged the client or couple to make an informed choice in 89% of the encounters. During most of the encounters, CHVs presented at least one method advantage for condoms (91%), DMPA (96%), and combination oral contraception (COC) (94%). However, CHVs presented method advantages in fewer of the encounters for implants (56%), progestin-only pills (61%), intrauterine devices (56%), tubal ligation (57%) and vasectomy (54%). Sixty-nine percent of CHVs asked sufficient questions from the checklist for ruling out pregnancy. CHVs asked all necessary questions to assess contraindications in 41% of the encounters in which the client expressed interest in oral contraception use and 83% of the encounters in which the client was interested in DMPA use. CHVs properly classified eligibility in 91% of the encounters involving oral contraception and 93% involving DMPA (see Appendices B1-B3 for checklists).

CHV mean performance scores based on their five client encounters ranged from 40.7 to 100 points with a mean score of 73.9 (95% CI: 70.3, 77.6) (Figures 8a and 8b). Only three variables were associated with performance scores in the adjusted analysis (Tables 22 and 23). For every additional year of education completed, performance scores increased by an average of 1.8 points (95% CI: 0.5, 3.1). Every additional weekly work hour as a CHV increased the performance score by 0.3 points (95% CI: 0.0, 0.6). Finally, receiving a refresher training after

the initial family planning training increased the performance score by 13.2 points (95% CI: (6.7, 19.7)).

LIMITATIONS

This evaluation has several limitations. The quality of c-IMCI CHV performance was determined by comparing the CHV case findings to that of a gold standard evaluator. It is possible that the gold standard evaluator made an error in some cases although every effort was made to train and prepare evaluation staff by reviewing and standardizing interpretation of the c-IMCI algorithm with practice cases and role plays. To investigate this, a secondary analysis of the correct treatment outcome determined by comparing the CHV treatment choice with the treatment standard ascribed by the classic c-IMCI algorithm based on the gold standard ill-child classification was performed. The overall CHV correct treatment outcome for c-IMCI treatable illnesses based on the algorithm-treatment standard was similar to the outcome based on the gold standard treatment choice.

We have limited information regarding the quality of child health or family planning services provided by health professional counterparts working in the formal health system in the survey area, which could have provided more context for interpreting the present results. Observation of community health workers (CHW) in a facility setting may overestimate the quality of care that they normally give in their villages. The Hawthorne effect or the phenomenon of health workers demonstrating improved performance has been described.[25, 26] Rowe et al. showed that the quality of observed performance by CHVs at health facilities was

superior when compared to the quality of services CHVs provide at their community sites in Kenya.[25] However, observing CHVs treating patients at their sites was not logistically feasible with the time and funding available. A strength of the evaluation design was the inclusion of simulated client encounters with real patients, which likely provided a better method of assessing services than simply relying on record reviews. The clients were not prompted nor trained, we did not use standardized patients, patients may have given different clinical histories to the CHV and the gold standard evaluator which could lead to different classification and treatment choices and ultimately bias the CHV performance score negatively.

We made 20 CHV substitutions which may bias the results because they were not selected by probability sampling. We believe this effect is likely to be small given the district and communes were selected by probability sampling and the substitutions came from the same geographical area. Other studies have found the similar challenges in finding and recruiting CHVs for observational studies because many are not available to participate for various reasons.[27,28]

Finally, this is a cross-sectional evaluation which by design is limited in its ability to identify temporal relationships between exposure variables and outcomes especially involving variables that change over time. A longitudinal study would be useful. Nonetheless this survey describes several program benchmark indicators important for health systems monitoring regarding service delivery, quality and performance, not previously reported in Madagascar.[22]

DISCUSSION

We described components of program functionality from the CHV perspective and evaluated the quality of care provided by CHVs to correctly manage ill children under five years old and counsel women in family planning and assess their contraceptive eligibility in Madagascar. Below is a discussion of our findings:

Program Functionality

CHVs overwhelmingly reported being recruited by their communities to work in the village where they reside and most recruitment selection criteria were respected per national guidelines.[29] Most of the c-IMCI CHVs reported the required minimum of at least 5 years of formal education; however, only 66% of RH/FP CHVs met the education criteria. Furthermore, additional years of education were shown to be significantly associated with better performance for both types of CHVs although the magnitude was small. Several CHVs were older than the maximum recommended age of 45 years. Given the potential skill and experience of older community members who are currently providing services and the investment in their training to date, the program may need to adapt to adequately support them. For example this may require providing corrective vision to those with age-related presbyopia to ensure they can read RDT results.[30]

CHVs said they understood their role and owned a written description of it; several CHVs also had participated in additional health activities in their communities. Given that the program relies on volunteer participation and in order to prevent attrition, the program should

examine cases where CHVs feel their volunteer activities conflict with their regular work. Local

solutions with support from other community members and the CoSan, such as task sharing,

should be sought.

The proportion of CHVs reporting stock outs is alarming and is a major threat to

program functionality, to the credibility of the CHVs in their communities, and can be

detrimental to the quality of services CHVs provide at their community sites.[27, 31] The CHV

network is highly decentralized and therefore a supply-chain challenge. From the beginning of

program scale-up, reliable supply-chain systems have not been developed of an adequate scope

nor an adequate pace to keep up with the number of CHV sites being opened. National

program and partners should reassess the supply-chain's ability to provide products and

develop a more realistic timeline needed to scale up in a quality manner.

Although most CHVs reported having had at least one supervision visit in the previous

12 months, it is worrisome that 13-21% said they were never supervised regularly. Among

CHVs who were supervised, most reported reviewing reports and registers with their supervisor

during visits although supervision of clinical encounters was rare. Barriers to effective referral

and counter-referral should be identified and addressed to ensure continuity of care for the

most vulnerable patients. Stock-out frequency, quarterly supervision, and the proportion of

effective referrals have been promoted as key benchmark indicators and the CHV program in

Madagascar should adopt and use these tools to monitor progress.[22]

Financial incentives were the most commonly cited motivating factors for becoming a

CHV, per diem for training was most often cited. In addition, about 20% of CHVs felt that

providing a regular salary was a necessary change to improve CHV performance. However,

adopting this approach would require a substantial financial commitment from the government

and raises questions about long-term sustainability. Similar large programs in Ethiopia and

Malawi provide financial incentives through regular pay to CHWs and high service quality has

been described.[11, 32]

C-IMCI – CHV performance

There are a few published studies that evaluate the quality of c-IMCI services provided

by CHVs through direct observation of clinical encounters and comparison to a gold standard

evaluation.[27, 33, 34] Several of these published studies have evaluated early pilot projects in

limited geographic areas. We assessed the quality of care provided by CHVs during the scale up

of a national program in Madagascar using expert observers and gold standard evaluators. We

also quantified and described several aspects of the program, from the CHV perspective, that

are typically related to program functionality and adequacy of implementation which will be

useful baseline information for future program monitoring.[22, 23]

c-IMCI CHVs in this evaluation were able to identify and evaluate children's symptoms

well, but performed sub-optimally when classifying and ultimately choosing the correct

treatment for ill children under 5 years old. CHVs correctly treated only half of children with c-

IMCI treatable illnesses. While these initial results seem worrisome they should be interpreted

with caution. There are no published data from Madagascar regarding the quality of care that

ill children receive in PHCs (i.e. "usual care") for comparison purposes. Several studies of case

management quality by PHC health workers in other countries using similar methods have been

published. Among PHC health workers in Bangladesh without IMCI training the quality of care

was reported to be very low with only 20% of children correctly classified and <50% of children

correctly treated.[31, 35, 36] Improved quality and performance has been described for[35] health

workers with IMCI training.[35, 37, 38] Even so, Huicho et al. report the proportion of children

correctly managed (assessed, classified, treated and counseled compared to a gold standard) by

health workers who had received IMCI training varied widely between 57-84% in a landmark

multi-country study (Bangladesh, Brazil, Uganda, Tanzania).[37] While direct comparisons cannot

be made because of slightly different methods (Malawi, on-site observation vs. Madagascar

health facility observation), our CHV performance results are not as strong as the recently

reported performance of CHWs in Malawi, known as health surveillance assistants (HSA), who

are c-IMCI trained and receive regular pay from the government in a program that has been

expanded nationally.[27] Gilroy et al. observed HSAs performing case management at their sites

in a cross sectional survey and also conducted a gold standard assessment of each ill child.

HSAs assessed children for the presence of fever, cough and diarrhea correctly 77% of the time,

however, they classified only 44% of the children correctly overall and correctly treated 68% of

children with CCM-treatable illnesses. However, presence of stock outs negatively influenced

treatment outcomes for management of fever and especially diarrhea – a factor that was not

assessed in our evaluation which was conductedat health facilities and   all necessary

medications and materials were provided in advance. Malawi's HSAs saw a median number of

41 patients per month vs. 4.3 patients per month seen by Madagascar's CHVs and by volume of

patients alone HSAs are likely to have more clinical experience than Madagascar CHVs, which

may contribute to the higher quality of their services and better performance.

In our evaluation, CHVs specifically did not perform well in determining if a child's respiratory rate was normal or abnormal for age and in deciding when to administer an RDT. Other programs have reported similar problems.[27, 39, 40] In addition, CHVs rarely prescribed antimalarials inappropriately (6.8%) demonstrating rational use of antimalarials similar to results of a recent multi-site randomized clinical in Africa.[30] This is reassuring on one hand as several programs have reported misuse of antimalarials and antibiotics previously.[27 41] On the other hand, CHVs in this evaluation often prescribed antibiotics for children with respiratory illness inappropriately and this should be reviewed and corrected during future technical supervision visits.

RDT use

The point of care malaria rapid diagnostic test is promoted by Madagascar's National Malaria Control Program and the World Health Organization to promote biologic confirmation of all malaria suspect cases resulting in the following potential benefits: improved patient care in parasite-positive patients, preventing unnecessary use of antimalarials (reducing frequency of adverse effects and minimizing drug pressure selecting for resistant parasites) and improved malaria case detection and reporting.[42-44] Importantly the advantage of using RDTs depends on the health provider's adherence to results in managing the patient. In this evaluation, RDT utilization was low among the CHVs. However, among CHVs that appropriately chose to use an RDT, the majority demonstrated technical proficiency in performing the test, interpreting results and were compliant to treatment guidelines accordingly. CHVs in Madagascar have previously demonstrated proficiency in conducting RDTs with high performance accuracy under small scale study conditions[45] as has been demonstrated in small studies elsewhere.[46-49] RDTs

have been effectively introduced in other community health worker programs on a larger scale with good performance in Zambia and Uganda.[29, 34, 50, 51] Our results describe CHV performance after scale-up of the program in Madagascar confirming that technically, RDTs can be effectively used on a larger scale at the community level. Key areas for program improvement are: emphasizing when it is appropriate to conduct an RDT, adhering to blood safety measures and reinforcing what to do if no control line is present indicating an invalid test result – an area of weakness reported in other programs that is correctable with supervision over time.[29]

We found that higher levels of education and higher scores on the knowledge assessment were associated with better performance. These could be used as tools to aid in recruitment of CHVs and in predicting and monitoring their performance. As it is not practical to perform a large observational cross sectional survey on a frequent basis, the knowledge assessment tool could serve as a proxy to assess CHV performance at regular intervals and aid in identifying those CHVs needing more technical supervision and/or targeted refresher training.

The CHVs performed well in classifying children's nutrition status and referring those children with severe malnutrition, but performed less well during the knowledge assessment in being able to name at least 2 signs of malnutrition. Only 64% of CHVs were able to name 2 signs of malnutrition: 56% correctly cited MUAC criteria, 37% cited pedal edema and 3% cited other appropriate signs. Interestingly, a greater number of responsibilities as self-reported or perceived by the CHV was also associated with a higher performance score. More responsibilities, including those beyond immediate c-IMCI responsibilities such as tuberculosis

treatment support; distributing or selling ITNs, participation in mother and child health week activities, reproductive health/family planning may indicate the CHV had more frequent and different types of training beyond the c-IMCI curriculum or more interaction with the PHC health staff, factors which could influenced their overall performance.

CHVs living a distance of >20 km from a health facility and those CHVs having less than six supervision visits in the preceding 12 months were factors associated with lower CHV performance scores. Long distances between CHV sites and health facilities are likely to limit communication and the ability for the CHV to engage with health facility staff and other supervisors. Remote sites present challenges to obtaining necessary support services which could influence site functionality. The finding that increased distance was associated with lower performance is particularly worrisome as Kashima et al. recently reported an association between increased distance from a PHC and higher child mortality in Madagascar underscoring the need to prioritize and provide high quality services in these underserved areas.[52]

Children presenting with complaints of cough or diarrhea were associated with lower CHV performance scores. However, we did not find a negative association between an increased number of chief complaints, suggesting more case management complexity and CHV performance. Furthermore, a study in Uganda demonstrated that community health workers could effectively evaluate and treat both malaria and pneumonia in febrile children and a program in Kenya showed increasing number of chief complaints were actually associated with better performance.[33, 53]

RH/FP CHV Performance

This evaluation of a systematically selected sample of RH/FP CHVs trained by Santénet2 in Madagascar revealed that many CHVs proved capable of providing high-quality contraception services. This finding is consistent with other evaluations that have identified benefits of CHV programs in delivering contraceptive services.[54-56] However, areas of deficiency were identified in the present evaluation. For example, imperfect results in screening for eligibility for oral contraception and DMPA could lead to critical medical errors. Also, CHVs appeared, in general, to provide better services related to DMPA than to other contraceptive methods. Given that injectable contraception is the most prevalent method in Madagascar[15], this could reflect a lack of practice or insufficient training on counseling on other methods.

We found few correlates of performance score based on simulated encounters with uninstructed volunteer clients. Education, weekly work hours as a CHV and receiving refresher training after the initial family planning training were positively associated with CHV performance score. However, the magnitude of these associations was relatively weak. These findings were consistent with an evaluation of a CHV program in Kenya, which did not find an association between intervention-related factors and CHV adherence to service guidelines.[33] In addition, although critical task performance scores were high overall, we identified areas of performance that should be improved to ensure high quality: striving for near perfect systematic use of job aids such as the pregnancy checklist to quickly identify women that might be pregnant and OCP and DMPA eligibility checklists as appropriate to ensure that OCPs and DMPA are administered correctly.

CHVs, traditional birth attendants, or other lay health workers could improve reproductive health by extending the reach of health care system in places where highly skilled professionals

are in short supply. Arguably, these volunteers could be used to deliver a range of services including HIV care[57], interventions to prevent perinatal transmission of HIV [58], and contraceptive services. Many studies suggest that CHV programs can increase rates of contraception use.[54-56, 59-64] CHVs can be particularly helpful if they are able to administer popular methods of contraception. The pattern of contraceptive use in Madagascar is similar to many resource-limited settings. Notably, injectable contraception is the most popular method in Eastern and Southern Africa, accounting for more than 40% of contraceptive use. The method has a reasonable safety profile and can be safely administered by CHVs.[65] A major issue with injectable contraception involves the high proportion of women who are late in attending visits for repeat injections. Greater access to local CHVs who could administer the method could be effective in ensuring the women receive timely repeat injections. A challenge is that CHVs probably could not be trained to safely administer long-acting and "forgettable" methods (e.g., implants and intrauterine devices), which may be more effective in preventing unintended pregnancy than methods that require more frequent user attention. However, CHVs could act as a link to the health care system, and injectables could be a bridge method to avoid unintended pregnancy while awaiting receipt of a longer-acting method.

A primary strength of the evaluation was use of systematic sampling, which provides results that are likely to be representative of CHV programs in Madagascar. Furthermore, each CHV completed five client or patient encounters, which could be expected to provide a more accurate view of services than evaluations relying on only single encounters. Another strength of this evaluation was the use of highly-trained observers to maximize the reliability of scoring

between encounters. Because the content of CHV training could vary slightly by region or partner, organizing a centralized training for the expert observers was important to allow us to review the c-IMCI treatment algorithm together, standardize definitions and techniques used for observations.

CONCLUSIONS

The purpose of the assessment was to describe the quality of care provided by CHVs in Madagascar and factors related to the function and implementation of the program.[23, 66] CHVs trained in c-IMCI in Madagascar commonly made errors in managing childhood illnesses similar to those reported for integrated community case management programs in other countries. c-IMCI CHVs performed well in identifying and evaluating a child's symptoms, however treatment quality was low. Specific classification skills that require strengthening were identified. CHVs demonstrated suboptimal performance in referring children with severe disease and poor performance in classifying and treating children with uncomplicated diarrhea, pneumonia, and fever when compared to a gold standard evaluator. The CHVs trained in RDTs demonstrated good technique in performing and interpreting RDTs correctly but did not always choose to perform one when indicated. Although areas of deficiency were identified, RH/FP-trained CHVs proved capable of providing high-quality contraception services especially in conducting the most medically critical tasks. Multivariable linear regression analysis identified factors associated with performance, which could be used to tailor and strengthen programs and identify those CHVs needing additional supervision and training. The magnitudes of the associations were small and any potential future program changes should be monitored and

evaluated to assess effectiveness. Elements of program functionality and several global benchmark indicators of the CHV program in Madagascar were described and can be used as a baseline for future program monitoring.

RECOMMENDATIONS

Revisions to the current program should be considered focusing on improving major weaknesses and promoting strengths in terms of program implementation adequacy and functionality identified in this report. The CHV supply chain is weak and could benefit from a careful analysis of constraints using existing information from this evaluation, other recent studies and program monitoring information to provide baseline evidence to redesign, develop and adopt performance improvement strategies and monitor results using a simple CHW supply chain framework that has been implemented in other countries.[67]

With the on-going national scale up of the CHV program in Madagascar, it is imperative to develop ways to optimize the quality of CHV performance to promote the best possible community health outcomes. c-IMCI CHV training, program supports and supervision should be aimed at emphasizing how to correctly classify and treat children with c-IMCI treatable illnesses. The importance of the rational prescription of antibiotics and when it is appropriate to test a child with an RDT should be reviewed and emphasized in refresher training. Post-training program supports should be developed and implemented in the context of a quality improvement process.[35] CHVs working in sites >20km from the nearest CSB have special needs in order to ensure equitable and effective technical and logistical program support services and

may require a novel approach beyond what the regular PHC infrastructure staff can offer, such sms technology for communication, reimbursement for long-distance travel, careful longer term logistics and supervision planning to accommodate long periods of time when remote sites may be inaccessible during the rainy season.

CHV competency could be monitored by assessing knowledge of different components of the c-IMCI algorithm, using a case-based questionnaire or similar tool as a practical potential predictor of the quality of individual CHV performance. Recruiting FP/RH CHVs with higher levels of education and establishing a minimum of weekly hours for c-IMCI CHVs to work or adding clinical practice sessions may improve the quality of services provided, however these potential future interventions should be monitored and evaluated appropriately given the small magnitude of the association described in this evaluation.

Monitoring using observation based methods can provide valuable information to inform programs. Madagascar would benefit from developing a comprehensive national CHV monitoring and evaluation systems approach using published guidelines that incorporate different methods to measure and monitor program benchmark performance over time especially in service delivery, quality and effective access to care.[22, 68] Longitudinal observational evaluations would be useful to assess if program changes improve CHV performance quality as the program evolves over time.

ROLE OF FUNDING SOURCE

ETHICAL CONSIDERATIONS

This evaluation was approved as non-human subjects research by the Office of the Associate Director for Science at the U.S. Centers for Disease Control and Prevention (CDC). The evaluation was also approved by the Ethics Committee in Madagascar.

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TABLES

Table 1. Items included in the performance score for CHVs implementing c-IMCI in Madagascar

Procedure Category	Procedure
Assessment	Agreement between CHV and gold standard on whether:
	1. Child has any danger sign present
	2. Child had cough or respiratory symptoms during illness
	3. If child had cough or respiratory symptoms: child had rapid respiratory rate
	4. If child had cough or respiratory symptoms: child had chest indrawing
	5. Child had diarrhea during illness
	6. If child had diarrhea: child unable to drink and vomiting everything
	7. If child had diarrhea: child had sunken eyes
	8. If child had diarrhea: child had bloody diarrhea
	9. If child had diarrhea: child had skin tenting (slow skin pinch)
	10. If child had diarrhea: child was irritable
	11. If child had diarrhea: child drinking eagerly
	12. Child had fever during illness
	13. If child had fever: child had neck stiffness
	14. If child had fever: child had sunken fontanelle
	15. If child had fever: child had been treated with ACT in the previous month[a]
Classification	Agreement between CHV and gold standard on whether:
	1. Child's MUAC was in green zone, yellow zone or red zone
	2. Child had severe respiratory illness, uncomplicated pneumonia, or cough
	3. Child had severe diarrhea or uncomplicated diarrhea
	4. Child had fever with danger signs or uncomplicated fever
Treatment and referral	Agreement between CHV and gold standard on whether:
	1. Child needing Cotrimoxazole was given Cotrimoxazole
	2. Child needing ACT was given ACT
	3. Child needing ORS was given ORS
	4. Child needing referral to HF was given referral to HF

CHV: Community health worker; ACT: Artemisinin-based combination therapy; MUAC: mid-upper arm circumference; ORS: Oral rehydration solution; HF: health facility
[a]Applies only to CHVs who had not yet received the new training curriculum

Table 2. Recommended and adequate or life-saving treatment for classification according to c-IMCI in

Madagascar

Classification	Correct Treatment	
	Recommended[a]	Adequate/Life-saving[b]
Age < 2 months	Referral to HF	Referral to HF
Severe respiratory illness		
2-59 months	Referral to HF	Referral to HF
Pneumonia		
2-5 months	CTM, exclusive BF	CTM
<u>6-59</u> months	CTM, homemade cough syrup	CTM
Cough		
2-5 months	Exclusive BF	
<u>6-59</u> months	Homemade cough syrup	
Severe diarrhea		
<2 months	Referral to HF and BF	Referral to HF
2-5 months	Referral to HF and ORS	Referral to HF
≥6 months	Referral to HF and ORS	Referral to HF
Uncomplicated diarrhea		
<2 months	Referral to HF, BF	Referral to HF
2-5 months	Zinc, ORS, BF	ORS
≥6 months	Zinc, ORS	ORS
Severe febrile illness	Referral to HF and paracetamol	Referral to HF
Uncomplicated malaria	ACT and paracetamol	ACT
Non-malarial fever	Referral to HF and paracetamol	Referral to HF
Severe malnutrition	Referral to HF	Referral to HF
Any other illness[c]		
2-59 months	Referral to HF	Referral to HF

HF: Health facility; CTM: cotrimoxazole; BF: breast feeding; ORS: Oral rehydration solution; ACT: artemisinin-based combination therapy

[a]Recommended treatment indicates treatment as per c-IMCI guidelines

[b]Adequate treatment indicates the components of the c-IMCI treatment steps that are potentially lifesaving (vs. symptomatic treatment)

[c]Any other illness: any illness outside the prevue of the CHV (i.e. any illness other than malnutrition, diarrhea, fever, respiratory illness)

Table 3. Items included in the performance score for CHVs implementing RH/FP in Madagascar

	Task
Part 1	1. Wears blouse/badge
	2. Welcomes client
	3. Assures the client about the confidentiality and privacy of the session
	4. Inquires about the client's residence
	5. Inquires about the client's age
	6. Helps the client to express needs
	7. Uses documents for counseling on available contraceptive methods
	8. Presents at least one advantage for the method
	a. Condoms
	b. CycleBeads
	c. Exclusive breastfeeding
	d. Depot medroxyprogesterone acetate (DMPA)
	e. Contraceptive implant
	f. Combination oral contraception (COC)
	g. Progestin-only pill
	h. Intrauterine device (IUD)
	i. Tubal ligation
	j. Vasectomy
	9. Encourages client or couple to make an informed choice
Part 2	1. Asks sufficient questions from checklist to be able to rule out pregnancy
	2. Does not suspect pregnancy among those with ≥1 factor from checklist ruling out pregnancy
	3. Asks all necessary questions to assess contraindications for oral contraception use among those expressing interest in this method
	4. Provides adequate counseling messages on oral contraception use
	5. Asks all necessary questions to assess contraindications for DMPA use among those choosing this method
	6. Properly classifies eligibility for DMPA use among those choosing this method
	7. Provides adequate counseling messages on DMPA use to women who choose and are eligible for the method

Table 4. CHVs by type, district, and supporting organization

| District or district group | c-IMCI-trained CHVs | | RH-trained CHVs |
	USAID-supported (n=99)	MoH/UNICEF-supported (n=50)	USAID-supported (n=100)
Ambositra	10	0	10
Andapa	10	0	10
Andilamena	0	10	0
Anjozorobe	10	0	10
AnkazoaboSud	9	0	10
Anosibe An'ala	0	10	0
Antanifotsy	10	0	10
Befandriana Nord	0	10	0
Beloha	10	0	10
Brickaville	10	0	10
Maevatanana	0	10	0
Mananjary	10	0	10
Midongy Atsimo and Vaingandrano	10	0	10
Moramanga	0	10	10
Soanieranalvongo	10	0	0

Table 5. Demographics by CHV type

| | c-IMCI-trained CHVs (n=149) | | | | RH-trained CHVs (n=100) | | | |
| | Unweighted | | Weighted | | Unweighted | | Weighted | |
	n	(%)	%	(95% CI)	n	(%)	%	(95% CI)
Gender								
Male	73	(49.0)	48.9	(39.3, 58.5)	50	(50.0)	46.6	(44.7, 48.5)
Female	76	(51.0)	51.1	(41.5, 60.7)	50	(50.0)	53.4	(51.5, 55.3)
Age (years) (mean)	41	NA	42.1	(40.3, 43.9)	40.0		40.2	(38.3, 42.2)
Age (years)								
20-29	16	(10.7)	10.2	(4.5, 15.8)	12	(12.0)	10.2	(9.1, 11.4)
30-39	48	(32.2)	28.3	(19.9, 36.8)	36	(36.0)	36.8	(35.0, 38.7)
40-45	42	(28.2)	26.6	(18.1, 35.1)	18	(18.0)	19.5	(18.1, 21.0)
>45	43	(28.9)	34.8	(25.6, 44.2)	34	(34.0)	33.5	(31.7, 35.3)
Years of education (years) (mean)	7.2		7.1	(6.7, 7.6)	7.3		7.3	(8.2, 11.1)
Level of education completed (years)								
<5	8	(5.4)	5.6	(0.9, 10.2)	33	(33.0)	33.8	(32.1, 35.6)
5-9	128	(85.9)	88.3	(82.0, 94.6)	57	(57.0)	54.5	(52.6, 56.4)
≥10	13	(8.7)	6.1	(1.6, 10.7)	10	(10.0)	11.7	(10.5, 13.0)
CHV site distance from nearest health facility (kilometers) (mean)	12.2		10.9	(9.6, 12.2)	10.3		9.6	(8.2, 11.1)
<5 km	18	(12.1)	15.7	(8.5, 23.1)	13	(13.8)	15.8	(14.4, 17.2)
5-10 km	58	(38.9)	41.6	(32.0, 51.1)	50	(52.3)	56.1	(54.2, 58.0)
11-20 km	59	(39.6)	35.7	(26.6, 44.7)	24	(25.5)	23.1	(21.5, 24.8)
>20 km	14	(9.4)	7.0	(2.3, 11.7)	7	(7.5)	5.0	(4.2, 5.9)

Duration of experience as CHV (months) (mean)	32.1	-	30.1	(26.7, 33.6)	26.1		23.8	(21.2, 26.4)
<6 months	3	(2.0)	1.5	(0.0, 3.4)	1	(1.0)	2.0	(1.5, 2.6)
6-12 months	18	(12.1)	11.6	(5.6, 17.7)	9	(9.1)	10.6	(9.5, 11.9)
13-24 months	64	(43.0)	48.9	(39.4, 58.6)	62	(62.6)	64.2	(62.4, 66.0)
25 months –5 years	54	(36.2)	32.3	(23.4, 41.1)	23	(23.2)	21.4	(19.9, 23.0)
>5 years–10 years	10	(6.7)	5.7	(1.3, 10.0)	4	(4.0)	1.8	(1.4, 2.4)
Prior experience[a]								
None	132	88.6	89.6	(83.7, 95.1)	89	(89.0)	87.9	(86.6, 89.1)
Traditional healer	2	1.3	1.7	(0.0, 2.3)	2	(2.0)	3.0	(2.4, 3.7)
Midwife	1	0.7	0.5	(0.0, 1.4)	2	(2.0)	3.2	(2.6, 4.0)
Community health supply distributor	14	9.4	10.2	(3.7, 16.5)	8	(8.0)	7.9	(7.0, 9.0)
Approximate weekly work hours as CHV (mean)	12.1		11.1	(9.2, 13.1)	11.5		11.2	(8.9, 13.5)

[a]Total can exceed 100% as CHVs could give more than one response

Table 6. Recruitment,roles and responsibilities, by CHV type

	c-IMCI-trained CHVs (n=149)				RH-trained CHVs (n=100)			
	Unweighted		Weighted		Unweighted		Weighted	
	n	(%)	%	(95% CI)	n	(%)	%	(95% CI)
Organization supporting site[a]								
MOH	56	(37.6)	25.8	(17.9, 33.7)	7	(7.0)	4.4	(3.7, 5.3)
USAID	90	(60.4)	74.1	(66.2, 82.0)	87	(87.0)	92.2	(6.9, 8.9)
Other	20	(13.4)	10.7	(5.1, 16.3)	10	(10.0)	7.5	(6.5, 8.5)
Organization supervising CHV[a]								
Non-governmental organization	82	(55.0)	61.6	(52.3, 70.8)	76	(76.0)	77.1	(75.5, 78.6)
Health facility	118	(79.2)	76.2	(67.8, 84.5)	66	(66.0)	69.0	(67.2, 70.7)
Other	21	(14.1)	16.3	(9.4, 23.3)	20	(20.0)	18.8	(17.4, 20.4)
Group or individual responsible for recruiting or choosing CHV								
Members of the community	125	(83.9)	87.6	(81.9, 93.3)	79	(79.0)	82.6	(81.1, 84.0)
Non-governmental organization	5	(3.4)	2.7	(0.0, 5.8)	2	(2.0)	1.4	(1.0, 1.9)
CDS	8	(5.4)	6.6	(1.9, 11.3)	8	(8.0)	7.8	(6.9, 8.9)
CoSan	7	(4.7)	4.9	(0.7, 9.0)	6	(6.0)	3.9	(3.2, 4.7)
Fokontany chief	52	(34.9)	25.9	(17.9, 33.9)	35	(35.0)	31.4	(29.6, 33.1)
Women of the village	2	(1.3)	0.9	(0.0, 2.6)	1	(1.0)	0.7	(0.4, 1.1)
Another CHV	4	(2.7)	0.2	(0.0, 0.4)	1	(1.0)	0.7	(0.4, 1.1)
Family influence in village	0	(0.0)	0	–	0	(0.0)	0.0	–
Previously was volunteer CHV	5	(3.4)	3.1	(0.0, 6.6)	5	(5.0)	3.4	(2.8, 4.1)
Chief CSB	30	(20.1)	16.7	(9.6, 23.7)	12	(12.0)	10.6	(9.5, 11.8)
Other[b]	2	(1.3)	1.3	(0.0, 3.4)	0	(0.0)	0.0	–

Works in same village as where resides								
Yes	149	(100.0)	100.0	–	100	(100.0)	100.0	–
No	0	(0.0)	0.0	–	0	(0.0)	0.0	–
Aware of role as a CHV								
Yes	143	(96.0)	94.2	(89.6, 97.4)	90	(90.0)	88.6	(87.4, 89.8)
No	6	(4.0)	4.8	(0.6, 8.7)	10	(10.0)	11.4	(10.2, 12.6)
Has a written description of responsibilities								
Yes	148	(99.3)	99.7	(99.2, 100)	100	(100.0)	100.0	–
No	1	(0.7)	1.1	(0.0, 2.4)	0	(0.0)	0.0	–
Among CHVs with a written description of job responsibilities, others who also are aware of the job description[a]								
CoSan	28	(18.9)	20.3	(12.4, 28.3)	19	(19.0)	16.5	(15.1, 17.9)
Chief CSB	125	(84.5)	87.3	(81.3, 93.3)	90	(90.0)	95.6	(94.8, 96.3)
CDS	58	(39.2)	50.1	(40.5, 59.7)	51	(51.0)	53.3	(51.4, 55.2)
Non-governmental organization	55	(37.2)	43.1	(33.5, 52.7)	53	(53.0)	56.3	(54.4, 58.1)
Fokontany chief	105	(70.9)	67.0	(58.0, 75.9)	61	(61.0)	64.7	(62.9, 66.5)
Other CHV	87	(58.8)	57.7	(48.2, 67.2)	57	(57.0)	60.1	(58.2, 61.9)
The community	79	(53.4)	47.3	(37.7, 57.0)	51	(51.0)	51.9	(50.0, 53.8)
Among CHVs with a written description of job responsibilities, others in their community with a written copy[a]								
CoSan	5	(3.4)	2.5	(0, 5.1)	6	(6.0)	5.0	(4.2, 5.9)
Chef CSB	87	(58.8)	58.3	(48.8, 67.8)	56	(56.0)	59.1	(57.2, 60.9)
CDS	14	(9.5)	11.5	(5.5, 17.4)	23	(23.0)	22.0	(20.5, 23.6)
Non-governmental organization	42	(28.4)	34.8	(25.5, 44.0)	38	(38.0)	37.3	(35.5, 39.2)

Fokontany chief	9	(6.1)	4.9	(1.2, 8.6)	6	(6.0)	7.8	(6.9, 8.9)
Other CHV	94	(63.5)	63.4	(54.3, 72.5)	65	(65.0)	67.4	(65.6, 69.1)
Activities included in CHV duties								
Counsel mothers on child health	147	(98.7)	99.5	(98.7, 100)	70	(70.0)	69.6	(67.8, 71.3)
Nutrition counseling	148	(99.3)	99.8	(99.4, 100)	62	(62.0)	63.9	(62.1, 65.7)
Sanitation and hygiene counseling	148	(98.7)	99.6	(98.8, 100)	89	(89.0)	90.4	(89.2, 91.4)
Care for ill children <5 yrs of age	143	(96.0)	98.2	(96.6, 99.7)	5	(5.0)	4.0	(3.4, 4.8)
Verify vaccination status	144	(96.6)	98.4	(96.9, 99.9)	28	(28.0)	30.8	(29.1, 32.6)
Child growth monitoring	141	(94.6)	94.8	(90.5, 99.2)	10	(10.0)	9.0	(8.0, 10.1)
Use RDTs in children with fever	126	(84.6)	84.6	(77.7, 91.4)	3	(3.0)	2.5	(2.0, 3.1)
Refer patients to nearest health facility	144	(96.6)	98.6	(97.2, 99.9)	68	(68.0)	71.6	(69.9, 73.3)
Give vitamin A to children	126	(84.6)	82.7	(75.3, 90)	68	(68.0)	70.7	(69.0, 72.4)
Treat tuberculosis with DOT	107	(71.8)	71.2	(62.6, 79.7)	3	(3.0)	2.7	(2.2, 3.4)
Give paracétamol	136	(91.3)	91.7	(86.3, 97.2)	6	(6.0)	5.4	(4.6, 6.3)
Give ACTIPAL (ACT combo)	136	(91.3)	92.6	(87.6, 97.6)	4	(4.0)	2.7	(2.2, 3.4)
Give oral rehydration solution	143	(96.0)	98.6	(97.3, 99.8)	5	(5.0)	4.7	(4.0, 5.6)
Give zinc	141	(94.6)	97.0	(94.1, 99.9)	4	(4.0)	2.7	(2.2, 3.4)
Give cotrimoxazole	132	(88.6)	90.0	(84.2, 95.8)	5	(5.0)	4.7	(4.0, 5.6)
Give out or sell ITNs	58	(38.9)	33.8	(24.8, 42.9)	23	(23.0)	21.8	(20.3, 23.4)
Give or sell water treatment kits	95	(63.8)	66.2	(57.4, 75.0)	61	(61.0)	69.0	(67.2, 70.7)
Counsel on breastfeeding	138	(92.6)	94.0	(90.0, 98.1)	90	(90.0)	91.7	(90.6, 92.7)
Family planning counseling	59	(39.6)	35.0	(25.9, 44.0)	100	(100.0)	100.0	(99.9, 100.0)
Counsel pregnant to take IPTp during pregnancy to prevent malaria	96	(64.4)	63.4	(54.3, 72.7)	87	(87.0)	85.3	(83.9, 86.6)

Health counseling to pregnant women and mothers	93	(62.4)	59.4	(49.9, 68.8)	92	(92.0)	92.7	(91.7, 93.6)
Give vitamin A to women after delivery	61	(40.9)	42.7	(33.2, 52.3)	30	(30.0)	31.6	(29.9, 33.3)
Prescribe family planning medications	14	(9.4)	3.6	(1.6, 5.7)	97	(97.0)	97.2	(96.5, 97.8)
Perform DMPA injections	7	(4.7)	2.2	(0.0, 4.4)	96	(96.0)	94.6	(93.6, 95.4,)
Provide condoms	14	(9.4)	5.4	(1.7, 9.0)	90	(90.0)	94.7	(93.7, 95.4)
Give folic acid to pregnant women	7	(4.7)	5.4	(1.0, 9.8)	22	(22.0)	17.8	(16.4, 19.3)
Responsible for patient type								
Children < 5 years of age only	143	(96.0)	98.5	(97.2, 99.8)	2	(2.0)	1.7	(1.3, 2.2)
Children and adults equally	6	(4.0)	1.5	(0.2, 2.8)	–	–	–	–
Adults only	0	(0.0)	0.0		–	–	–	–
Reproductive-age women	-	-	-	-	98	(98.0)	98.3	(97.8, 98.8)

CDS = Commite Communale de Development Sociale; CoSan = Communauté Sanitaire (community health committee); RDT=Rapid Diagnostic Test for malaria; DOT=Directly-observed therapy; ACT=Artemisinin-based combined therapy; ITN=Insecticide-treated bednet; IPTp=Intermittent preventative therapy during pregnancy for malaria; DMPA = depot medroxyprogesterone acetate
[a] Total can exceed 100% as could select more than one response
[b] Included "chosen because of literacy" and "chosen by district authorities"

Table 7. Training by CHV type

	c-IMCI-trained CHVs (n=149)				RH-trained CHVs (n=100)			
	Unweighted		Weighted		Unweighted		Weighted	
	n	(%)	%	(95% CI)	n	(95% CI)	%	(95% CI)
Type of training received								
IMCI only	146	(98.0)	99.4	(98.8, 100)	0	(0.0)	–	–
RH only	0	0.0	–	–	100	(100.0)	100.0	(99.9, 100.0)
Both IMCI and RH	3	(2.0)	0.6	(0.0, 1.2)	0	(0.0)	–	–
Source of initial training[a]								
NGO	117	(78.5)	85.0	(77.8, 91,2)	96	(96.0)	97.9	(97.3, 98.4)
Chef CSB	53	(35.6)	27.5	(19.2, 35.7)	27	(27.0)	29.3	(27.1, 31.1)
Region	0	(0.0)	0.0		1	(1.0)	0.7	(0.4, 1.1)
District	21	(14.1)	5.3	(2.2, 8.4)	4	(4.0)	2.7	(2.2, 3.4)
Other	22	(14.8)	15.5	(8.6, 22.3)	3	(3.0)	2.0	(1.5, 2.6)
Topics included in initial training								
Nutrition	100	(67.1)	69.9	(61.2, 78.6)	15	(15.0)	13.6	(12.3, 14.9)
Maternal & child health counseling	85	(57.0)	59.7	(50.4, 69.0)	34	(34.0)	30.1	(28.4, 31.8)
Child Growth Monitoring	103	(69.1)	71.2	(62.5, 79.8)	6	(6.0)	5.3	(4.5, 6.2)
c-IMCI	134	(89.9)	88.9	(82.9, 94.9)	7	(7.0)	6.2	(5.4, 7.2)
Vaccination	60	(40.3)	37.8	(28.5, 47.2)	9	(9.0)	7.2	(6.3, 8.3)
DMPA	4	(2.7)	0.8	(0.0, 1.5)	98	(98.0)	98.7	(98.1, 99.0)
Family planning	6	(4.0)	1.9	(0.3, 3.5)	86	(86.0)	88.4	(87.2, 89.6)
Safe motherhood	23	(15.4)	15.1	(8.3, 22.0)	47	(47.0)	48.6	(46.7, 50.5)
Water hygiene	71	(47.7)	52.4	(42.9, 62.0)	47	(47.0)	44.9	(43.0, 46.7)

	n	(%)			n	(%)		
Management and planning	88	(59.1)	62.8	(53.6, 72.0)	51	(51.0)	54.6	(52.7, 56.4)
Refresher training received								
Yes	90	(60.4)	53.9	(44.3, 63.5)	32	(32.0)	31.2	(29.5, 32.9)
No	59	(39.6)	40.3	(34.8, 44.2)	68	(68.0)	68.8	(67.1, 70.6)
Among those receiving refresher training, months since refresher training (mean)	8.0	–	8.1	(6.8, 9.3)	8.1	–	8.1	(4.9, 11.3)
Among those receiving refresher training, duration of refresher training in days (mean)	5.8	–	5.2	(4.5, 6.0)	3.3	–	3.3	(2.7, 4.0)
Felt capable of performing IMCI after initial training								
Yes	112	(78.9)	77.8	(69.5, 86.2)	–	–	–	–
No	4	(2.8)	5.4	(69.5, 86.2)	–	–	–	–
Partially	26	(18.3)	16.7	(9.4, 23.9)	–	–	–	–
Felt capable of providing contraceptive counseling after initial training								
Yes	–	–	–	–	90	(90.0)	87.9	(86.6, 89.1)
No	–	–	–	–	2	(2.0)	2.6	(2.1, 3.3)
Partially	–	–	–	–	8	(8.0)	9.4	(8.4, 10.6)
Felt comfortable providing DMPA injections after initial training								
Yes	–	–	–	–	61	(61.0)	58.3	(56.4, 60.2)
No	–	–	–	–	20	(20.0)	25.2	(23.6, 26.9)
Partially	–	–	–	–	16	(16.0)	16.5	(15.1, 17.9)

DMPA = depot medroxyprogesterone acetate; RH = reproductive health
[a] Total can exceed 100% as could select more than one response

Table 8. Supervision by CHV type

	c-IMCI-trained CHVs (n=149)				RH-trained CHVs (n=100)			
	Unweighted		Weighted		Unweighted		Weighted	
	n	(%)	%	(95% CI)	n	(%)	%	(95% CI)
Examined >1 child in presence of supervisor in village in past year (n=141)								
Yes	61	(43.3)	43.1	(33.3, 52.9)	–	–	–	–
No	80	(56.7)	56.9	(47.1, 66.7)	–	–	–	–
Among those reporting having examined >1 child in presence of supervisor in village in past year, no. of children examined (n=61)								
1–2	22	(36.1)	37.5	(20.8, 54.1)	–	–	–	–
3–10	28	(45.9)	58.7	(42.6, 74.7)	–	–	–	–
>10	5	(8.2)	9.2	(0.0, 19.1)	–	–	–	–
Don't know	6	(9.8)	10.4	(0.0, 22.6)	–	–	–	–
Examined >1 child in presence of supervisor at health facility in past year (n=122)								
Yes	71	(58.2)	52.7	(42.0, 63.3)	–	–	–	–
No	51	(41.8)	47.3	(36.7, 58.0)	–	–	–	–
Among those reporting having examined >1 child in presence of supervisor at health facility in past year, no. of children examined (n=71)								
1–2	35	(49.3)	42.4	(27.9, 57.0)	–	–	–	–
3–10	32	(45.1)	53.9	(39.2, 68.7)	–	–	–	–

>10	2	(2.8)	1.8	(0.0, 4.1)	–	–	–	–
Don't know	2	(2.8)	1.9	(0.0, 4.2)	–	–	–	–
Ever conducted contraceptive counseling or method provision in front of supervisor								
Yes	–	–	–	–	32	(32.0)	29.1	(27.4, 30.9)
No	–	–	–	–	68	(68.0)	70.9	(69.2, 72.6)
Among those conducting contraceptive counseling or method provision in front of supervisor in the past 12 months, number of times (mean)	–	–	–	–	4.2	–	4.2	(2.4, 5.9)
Provided services to women in the primary health center in front of supervisor in past 12 months								
Yes	–	–	–	–	61	(61.0)	58.7	(56.8, 60.6)
No	–	–	–	–	35	(35.0)	41.3	(39.4, 43.2)
Among those providing services to women in the primary health center in front of supervisor in past 12 months, number of times (mean)	–	–	–	–	11.0	–	10.1	(4.7, 15.4)
Frequency of technical supervision								
More than once per month	5	(3.4)	3.1	(0.0, 6.3)	5	(5.0)	4.8	(4.1, 5.7)
Once per month	68	(45.6)	41.2	(31.7, 50.6)	44	(44.0)	47.3	(4.5, 4.9)
Once every 3 months	36	(24.2)	27.1	(18.5, 35.8)	26	(26.0)	23.7	(22.1, 25.3)
Once every 6 months	11	(7.4)	7.2	(2.2, 12.1)	9	(9.0)	8.4	(7.4, 9.5)
Never	26	(17.4)	20.6	(12.7, 28.5)	12	(12.0)	12.8	(11.6, 14.1)
Don't know	3	(2.0)	0.7	(0, 1.6)	4	(4.0)	3.0	(2.4, 3.7)
No. of supervision visits in prior 12 months								

0	3	(2.4)	1.9	(0.0, 4.6)	0	(0.0)	–	–
1–2	19	(15.4)	14.4	(7.0, 21.9)	13	(13.0)	13.1	(5.7, 20.5)
3–5	47	(38.2)	36.3	(25.9, 46.7)	32	(32.0)	31.9	(21.3, 42.4)
6–8	7	(5.7)	4.5	(0.0, 9.1)	4	(4.0)	3.2	(0.0, 6.6)
9-10	13	(10.6)	16.1	(7.6, 24.6)	1	(1.0)	1.3	(0.0, 3.8)
≥11	34	(27.6)	26.8	(17.7, 36.0)	36	(36.0)	38.0	(27.5, 48.6)
Missing	26	(17.4)	19.2	(14.4, 24.6)	14	(14.0)	12.5	(5.8, 19.2)
Among those reporting that they have been supervised technically, activity performed by supervisor at last visit[a]								
Checked the individual child patient form	110	(89.4)	87.2	(79.4, 95.0)	–	–	–	–
Checked the child register	110	(89.4)	85.8	(77.6, 94.1)	–	–	–	–
Checked the monthly report	120	(97.6)	98.7	(96.1, 100)	86	(98.9)	97.7	(97.0, 98.3)
Observed encounter at your site	68	(55.3)	58.0	(47.3, 68.6)	31	(35.6)	29.8	(28.0, 31.7)
Observed encounter at health facility	73	(59.3)	55.6	(44.7, 66.4)	48	(55.2)	51.0	(48.9, 53.0)
Checked supplies and medications	81	(65.9)	63.1	(52.5, 73.6)	62	(71.3)	68.2	(66.3, 70.1)
Discussed problems with your site	107	(87.0)	90.9	(85.0, 96.8)	69	(79.3)	82.6	(81.0, 84.1)
Gave advice or feedback	111	(90.2)	92.1	(86.0, 98.3)	77	(88.5)	87.4	(86.0, 88.7)
Worked together to identify solutions	105	(85.4)	89.9	(83.7, 96.2)	74	(87.1)	87.1	(85.7, 88.5)
Received formal evaluation								
Yes	72	(48.3)	51.8	(42.3, 61.4)	52	(52.0)	53.5	(51.6, 55.4)
No	77	(51.7)	48.1	(38.6, 57.7)	48	(48.0)	46.5	(44.6, 48.4)
Among CHVs receiving a formal evaluation, person providing it[a]								

Community member	4	(5.6)	5.3	(0.0, 11.1)	1	(1.9)	2.1	(1.5, 2.9)
Head of health facility	38	(52.8)	53.0	(39.2, 66.7)	29	(55.8)	54.4	(51.8, 57.0)
Santénet2 or UNICEF representative	35	(48.6)	44.4	(30.6, 58.1)	20	(38.5)	37.5	(35.0, 40.0)
Representative of another NGO	21	(29.2)	29.3	(16.9, 41.8)	21	(40.4)	41.7	(39.2, 44.3)
Technical assistant	11	(15.3)	7.1	(1.1, 13.2)	4	(7.7)	9.1	(7.8, 10.7)
Other	5	(6.9)	6.1	(0, 12.4)	5	(9.6)	10.9	(9.4, 12.6)
Among CHVs receiving a formal evaluation, method of evaluation[a]								
Direct observation of evaluation	45	(62.5)	62.6	(49.4, 75.7)	31	(59.6)	58.5	(55.9, 61.0)
Simulated patient	42	(58.3)	62.4	(49.0, 75.7)	36	(69.2)	67.4	(64.9, 69.7)
Checked job aids/supplies	66	(91.7)	91.7	(84.8, 98.6)	49	(94.2)	93.6	(92.2, 94.7)
Asked you knowledge questions	68	(94.4)	96.3	(92.2, 100)	48	(92.3)	96.1	(95.0, 97.0)
Asked questions about your activities	71	(98.6)	99.2	(97.7, 100)	51	(98.1)	99.3	(98.7, 99.6)
Checked expiration dates on medications and supplies	58	(80.6)	80.1	(69.5, 90.7)	37[b]	(71.2)	73.9	(71.6, 76.1)
Requested information about inventory	69	(95.8)	96.3	(91.0, 100)	46	(88.5)	92.1	(90.6, 93.4)
Requested information about stock outs	65	(90.3)	91.9	(84.9, 98.9)	43	(82.7)	85.2	(83.2, 86.9)
Other	2	(2.8)	3.0	(0.0, 7.6)	4	(7.7)	8.8	(7.5, 10.4)
Among CHVs receiving a formal evaluation, skills assessed[a]								
Classification of illness	69	(95.8)	96.2	(90.6, 100)	–	–	–	–
Treatment	66	(91.7)	94.7	(88.1, 99.9)	–	–	–	–
Performance of diagnostic tests	58	(80.6)	83.8	(74.0, 93.6)	–	–	–	–
Appropriateness of referrals	67	(93.7)	93.8	(87.5, 100)	35	(68.6)	67.3	(64.8, 69.7)

Counseling	67	(93.7)	94.0	(87.8, 100)	44	(86.3)	85.9	(84.0, 87.6)
Family planning skills	7	(9.7)	9.0	(0.9, 17.1)	51	(100.0)	100.0	(99.7, 100.0)
Ability to provide DMPA injections	2	(2.8)	0.8	(0.0, 1.9)	44	(86.3)	86.0	(84.1, 87.7)

DMPA = depot medroxyprogesterone acetate

[a] Total can exceed 100% as could select more than one response

Table 9. <u>Volume of patients seen by CHV type</u>

	c-IMCI-trained CHVs (n=149)				RH-trained CHVs (n=100)			
	Unweighted		Weighted		Unweighted		Weighted	
	n	(%)	n	(95% CI)	n	(%)	%	(95% CI)
Children seen last month (mean)	4.7	-	4.3	(3.3, 5.3)	–	–	–	–
Children seen in the past week (mean)	1.1	-	1.2	(0.9, 1.6)	–	–	–	–
Contraceptive services provided in past month (mean)	–	–	–	–	9.8		10.9	(7.6, 14.1)
Contraceptive services provided in past week (mean)	–	–	–	–	2.7		2.8	(1.6, 4.0)
Women using DMPA who attended site in past 3 months (mean)	–	–	–	–	13.5		15.0	(9.7, 20.4)
Women using oral contraception who attended site in past 3 months (mean)	–	–	–	–	8.5		9.4	(6.9, 12.0)
Women requesting condoms who attended site in past 3 months (mean)	–	–	–	–	0.6		0.7	(0.4, 1.1)

Table 10. Perceived motivational factors by CHV type

	c-IMCI-trained CHVs (n=149)				RH-trained CHVs (n=100)			
	Unweighted		Weighted		Unweighted		Weighted	
	n	(%)	%	(95% CI)	n	(%)	%	(95% CI)
Advantages of role as CHV from place of work (n=137)								
Feedback	103	(75.2)	75.6	(67.1, 84.2)	77	(86.5)	90.1	(88.8, 91.2)
Support	101	(73.7)	73.7	(64.9, 82.5)	79	(87.8)	91.3	(90.2, 92.3)
Regular finances	8	(5.8)	6.8	(1.8, 11.9)	1	(1.1)	1.2	(0.8, 1.7)
Per diem for training	126	(92.0)	90.0	(83.8, 96.2)	87	(96.7)	97.0	(96.2, 97.6)
Donations or gifts	32	(23.4)	18.5	(10.7, 26.3)	16	(17.8)	18.1	(16.7, 19.7)
Training and orientation	108	(78.8)	77.5	(69.2, 85.8)	80	(88.9)	88.7	(87.4, 89.8)
Official recognition	62	(45.3)	40.2	(30.4, 50.0)	27	(30.0)	24.9	(23.2, 26.6)
Other	17	(12.4)	12.8	(6.1, 19.5)	11	(12.5)	14.3	(13.0, 15.7)
No advantage	8	(5.8)	8.7	(2.8, 14.5)	13	(14.4)	13.4	(12.1, 14.8)
Advantages of role as CHV from community (n=147)								
Feedback	37	(25.2)	19.7	(12.0, 27.3)	24	(24.2)	23.4	(21.8, 25.0)
Support	63	(42.9)	40.8	(31.2, 50.4)	36	(36.4)	30.7	(29.0, 32.5)
Regular finances	23	(15.7)	14.4	(7.8, 20.9)	14	(14.1)	14.5	(13.2, 15.9)
Donations or gifts	17	(11.6)	10.6	(4.7, 16.4)	9	(9.1)	10.7	(9.6, 11.9)
Official recognition	108	(72.5)	71.6	(63.0, 80.1)	83	(83.0)	83.9	(82.4, 85.2)
Other	10	(6.8)	8.1	(2.6, 13.7)	9	(9.1)	7.7	(2.3, 13.0)
No advantage	96	(65.3)	67.4	(58.6, 76.3)	67	(67.1)	68.9	(67.2, 70.7)
Happy to be able to help community as a CHV (n=149)								

	n	(%)	%	(95% CI)	n	(%)	%	(95% CI)
Completely agree	137	(92.0)	93.0	(88.0, 97.9)	95	(95.0)	96.4	(95.7, 97.1)
Partially agree	9	(6.0)	4.8	(0.6, 8.9)	5	(5.0)	3.6	(2.9, 4.3)
Partially disagree	3	(2.0)	2.3	(0.0, 5.2)	0	(0.0)	0	–
Completely disagree	0	(0.0)	0.0	–	0	(0.0)	0	–
Not sure / declined to respond	0	(0.0)	0.0	–	0	(0.0)	0	–
Agree that there are opportunities for advancement (n=149)								
Yes	100	(67.1)	69.4	(60.1, 78.2)	75	(75.0)	75.7	(74.0, 77.2)
No or don't know	49	(32.9)	30.6	(21.8, 39.4)	25	(25.0)	24.4	(22.3, 26.0)
Among those agreeing there are opportunities for advancement, type of advancement[a]								
Position at health facility	30	(30.0)	39.0	(27.4, 50.5)	34	(45.3)	47.5	(45.3, 49.6)
Work part-time at health facility	37	(37.0)	44.7	(33.1, 56.3)	31	(41.3)	45.8	(43.6, 47.9)
Become a technical assistant	25	(25.0)	29.9	(19.1, 40.7)	28	(37.3)	36.8	(34.8, 39.0)
Attend training workshops	81	(81.0)	83.9	(75.6, 92.2)	70	(93.3)	94.7	(93.6, 95.6)
Learn new technical skills	76	(76.0)	78.4	(69.1, 87.7)	61	(81.3)	85.9	(84.3, 87.3)
Receive reward for performance	54	(54.0)	57.9	(46.3, 69.4)	43	(57.3)	62.8	(60.7, 64.9)
Other	17	(17.0)	16.4	(7.7, 25.1)	14	(18.7)	15.0	(13.5, 16.6)
Biggest challenges as a CHV[a]								
Finding time to see clients	33	(22.1)	22.7	(15.1, 30.2)	18	(18.0)	16.5	(15.1, 17.9)
Scheduling conflicts with regular work	35	(23.5)	18.7	(11.9, 25.4)	18	(18.0)	12.5	(11.3, 13.8)
Correct classification of illness	62	(42.3)	38.0	(28.9, 47.1)	30	(30.0)	26.8	(25.2, 28.5)
Determining appropriate treatment	58	(38.9)	36.3	(27.2, 45.5)	36	(36.0)	30.1	(28.4, 31.8)
Deciding when to refer to health facility	40	(26.8)	21.3	(14.1, 28.5)	19	(19.0)	14.7	(13.4, 16.1)

Gaining respect from community	44	(29.5)	28.0	(19.8, 36.2)	17	(17.0)	15.4	(14.1, 16.8)
Keeping adequate inventory of supplies and medications	86	(57.7)	51.0	(41.4, 60.7)	38	(38.0)	34.0	(32.2, 35.8)
Other	49	(32.9)	35.4	(26.0, 44.8)	46	(46.0)	50.6	(48.7, 52.5)
Changes needed to improve CHV work[a]								
More community support	37	(24.8)	24.4	(16.5, 32.4)	12	(12.0)	11.2	(10.1, 12.5)
More supervision	60	(40.3)	38.2	(29.0, 47.4)	31	(31.0)	26.9	(25.2, 28.6)
More training	78	(52.3)	47.2	(37.7, 56.8)	40	(40.0)	32.1	(30.4, 33.9)
More supplies and medications	53	(35.6)	35.1	(26.0, 44.2)	32	(32.0)	28.3	(26.6, 30.0)
Better access to health facility personnel	26	(17.4)	18.3	(11.3, 25.4)	12	(12.0)	10.9	(9.8, 12.1)
Regular restocking of medications	88	(59.1)	58.8	(49.3, 68.2)	51	(51.0)	46.7	(44.9, 48.6)
Other[a]	81	(54.3)	49.9	(40.3, 59.5)	72	(72.0)	73.0	(71.3, 74.6)
Bicycle	26	(32.1)	31.4	(26.1, 36.8)	25	(25.0)	26.6	(25.0, 28.3)
More money / salary	33	(40.7)	38.8	(32.3, 44.5)	22	(22.0)	23.7	(22.2, 25.4)
Housing	11	(13.6)	12.0	(8.4, 16.2)	3	(3.0)	4.2	(3.5, 5.1)
Supplies	9	(11.1)	10.3	(6.2, 13.8)	13	(13.0)	14.8	(13.5, 16.1)
Telephone	6	(7.4)	7.2	(4.7, 9.8)	0	(0.0)	0.0	–

[a] Total can exceed 100% as could select more than one response

Table 11. Supplies and equipment by CHV type

	c-IMCI-trained CHVs (n=149)				RH-trained CHVs (n=100)			
	Unweighted		Weighted		Unweighted		Weighted	
	n	(%)	%	(95% CI)	n	(%)	%	(95% CI)
Has necessary supplies to perform job at time of survey	149							
Yes	105	(71.0)	67.2	(58.0, 76.4)	66	(66.0)	64.0	(62.2, 65.8)
No	43	(29.0)	32.8	(23.6, 42.0)	33	(33.0)	34.0	(3.2, 3.6)
Don't know/Missing	1	(0.0)	0.0	-	1	(1)	2.0	(1.5, 2.6)
Ever experience a shortage of medication or supplies	147							
Yes	94	(64.0)	67.0	(57.9, 76.1)	67	(67.0)	70.0	(68.3, 71.7)
No	53	(36.0)	33.0	(23.9, 42.1)	33	(33.0)	30.0	(28.3, 31.7)
Among those experiencing a shortage, no. of times in past 6 months (mean)	1.4	–	1.4	(1.2, 1.6)	1.7	–	1.8	(1.5, 2.1)
Among those experiencing a shortage, no. of times in past 6 months (range)	1–4	–	–	–	1–5	–	–	–
Among those experiencing a shortage, type of shortage [a]								
ACT	21	(22.3)	24.8	(16.9, 38.8)	25	(25.0)	25.1	(23.5, 26.8)
Cotrimoxazole	22	(23.4)	26.0	(15.2, 36.8)	9	(9.0)	7.7	(6.7, 8.7)
Paracetamol	26	(27.7)	30.0	(18.7, 41.3)	15	(15.0)	15.2	(13.9, 16.6)
ORS	21	(22.3)	21.7	(5.0, 31.6)	12	(12.0)	11.2	(10.1, 12.5)
DPMA	16	(17.0)	14.0	(5.8, 22.2)	16	(16.0)	15.3	(14.0, 16.8)
Pilplan	12	(12.8)	14.6	(6.6, 24.6)	20	(20.0)	21.2	(19.7, 22.8)
RDT	4	(4.3)	5.8	(0.2, 13.5)	–		–	

Zinc	15	(16.0)	16.8	(7.2, 25.0)	13	(13.0)	11.7	(10.6, 13.0)
All medications/never supplied	17	(18.1)	21.9	(12.4, 33.4)	4	(4.0)	4.7	(4.0, 5.6)

Among those experiencing a shortage, duration of last shortage (n=94)

<1 week	16	(17.0)	11.9	(2.8, 15.8)	3	(4.8)	3.6	(2.8, 4.6)
1–2 weeks	17	(18.1)	19.8	(10.1, 29.5)	15	(24.2)	25.5	(23.5, 27.6)
3–4 weeks	12	(12.8)	13.0	(4.9, 21.2)	13	(21.0)	21.1	(19.2, 23.1)
1–3 months	27	(28.7)	28.7	(17.6, 39.7)	18	(29.0)	27.4	(25.3, 29.5)
>3 months	20	(21.3)	23.8	(13.1, 34.6)	12	(19.4)	20.7	(18.9, 22.7)
Don't know	2	(2.1)	4.0	(0.0, 10.6)	1	(1.6)	1.7	(1.2, 2.5)

Among those experiencing a shortage, actions taken by CHV to resolve shortage (n=94)

Requested from health facility	47	(50.0)	47.2	(35.4, 59.0)	20	(29.9)	25.2	(23.3, 27.2)
Requested from CoSan	4	(4.3)	6.1	(0.2, 12.1)	1	(1.5)	1.0	(0.6, 1.5)
Requested from the PSI supply point	11	(11.7)	12.5	(4.8, 20.1)	7	(10.5)	10.1	(8.7, 11.5)
Requested from the NGO	8	(8.5)	11.1	(3.2, 18.9)	7	(10.5)	8.6	(7.4, 10.0)
Waited for scheduled replenishment	5	(5.3)	2.7	(0.0, 5.8)	5	(7.5)	8.1	(7.0, 9.4)
Notified supervisor	4	(4.3)	4.6	(0.0, 9.6)	3	(4.5)	4.6	(3.7, 5.6)
Informed the TA	18	(19.1)	22.8	(12.9, 32.7)	15	(22.4)	20.5	(18.8, 22.4)
Bought medication from pharmacy	9	(9.6)	11.1	(3.3, 19.0)	8	(11.9)	11.1	(9.8, 13.2)
Sent patients to another CHV	3	(3.2)	3.7	(0.0, 8.5)	2	(3.0)	2.6	(1.8, 4.0)
Referred clients to health facility	6	(6.4)	6.3	(0.8, 10.4)	10	(14.9)	15.4	(12.2, 18.6)
Other	6	(6.4)	5.8	(1.2, 7.9)	8	(41.8)	46.8	(44.5, 49.0)
Don't know	6	(6.4)	6.4	(2.1, 9.5)	0	(0.0)	0	–

Frequency of restock/resupply (n=145)							
Every 2 weeks	3	(2.1)	1.8	(0.0, 4.1)	3	(3.0)	1.9	(1.5, 2.5)
Every month	22	(15.2)	12.6	(6.4, 18.7)	20	(20.0)	19.0	(17.6, 20.5)
Every 2 months	8	(5.5)	5.6	(1.2, 10.1)	8	(8.0)	6.6	(5.7, 7.6)
Every 3 months	7	(4.8)	6.5	(1.6, 11.4)	5	(3.0)	4.8	(4.1, 5.7)
Every 6 months	0	(0.0)	0	–	1	(1.0)	1.1	(0.1, 1.6)
Only when needed	75	(51.7)	50.3	(40.6, 60.1)	48	(48.0)	47.0	(45.2, 48.9)
Never	22	(15.2)	15.6	(8.4, 22.9)	8	(8.0)	9.2	(8.2, 10.4)
Other	8	(5.5)	7.5	(1.9, 13.1)	7	(7.0)	10.3	(9.2, 11.5)
Tools used in CHV duties							
Patient register	143	(96.0)	95.8	(92.4, 99.3)	98	(98.0)	98.0	(97.4, 98.4)
Individual patient form	142	(95.3)	94.5	(90.3, 98.7)	93	(93.0)	92.9	(91.9, 93.8)
Supervision form	53	(35.6)	28.0	(19.2, 36.6)	41	(41.0)	35.3	(33.5, 37.1)
Order form	87	(58.4)	51.5	(41.8, 61.1)	56	(56.0)	48.4	(46.6, 50.4)
Supply form	111	(74.5)	73.1	(64.7, 81.6)	77	(77.0)	71.9	(70.2, 73.6)
Monthly report form	145	(97.3)	96.0	(92.3, 99.7)	99	(99.0)	99.3	(98.9, 99.6)
Instruction manual	135	(90.6)	90.4	(85.1, 95.8)	87	(87.0)	89.7	(88.5, 90.8)
RUMER (medication / finance register)	58	(38.9)	33.0	(24.4, 41.7)	28	(28.0)	24.3	(22.7, 25.9)
Method of obtaining forms							
Sent by health facility	24	(16.1)	12.7	(6.9, 18.5)	11	(11.0)	10.3	(9.2, 11.5)
Given by supervisor	8	(5.4)	4.8	(0.7, 8.9)	4	(4.0)	3.1	(2.5, 3.9)
Given by TA	73	(49.0)	47.9	(38.3, 57.5)	55	(55.0)	51.6	(49.7, 53.5)
Pick up from health facility	31	(20.8)	20.3	(12.7, 27.9)	12	(12.0)	10.1	(9.0, 11.3)
Pick up from other CHVs	3	(2.0)	0.6	(0.0, 1.2)	2	(2.0)	1.9	(1.4, 2.5)
Make photocopies	3	(2.0)	0.8	(0.0, 1.4)	1	(1.0)	1.3	(1.0, 1.9)

Obtained at training session	15	(10.1)	9.6	(1.4, 16.3)	20	(20.0)	23.6	(22.1, 25.3)
Other	7	(4.7)	4.2	(0.0, 8.2)	5	(5.0)	6.4	(5.6, 7.4)

ACT: Artemisinin-based combination therapy; ORS: Oral rehydration solution; DMPA = depot medroxyprogesterone acetate; Pilplan: oral contraceptives; RDT: Rapid diagnostic test for malaria; CoSan: Communauté Sanitaire (community health committee; PSI: Population Services International ; TA: Technical advisor; RUMER: Medication register

[a] Total can exceed 100% as could select more than one response

Table 12. Recordkeeping and referrals by CHV type

	c-IMCI-trained CHVs (n=149)				RH-trained CHVs (n=100)			
	Unweighted		Weighted		Unweighted		Weighted	
	n	(%)	%	(95% CI)	n	(%)	%	(95% CI)
Submit reports								
Yes	146	(98.0)	96.5	(92.8, 100.)	100	(100.0)	100.0	(99.9, 100.0)
No	3	(2.0)	3.5	(0.0, 7.8)	0	(0.0)	0.0	
Among those submitting reports, frequency of submission								
Monthly	145	(99.3)	99.9	(99.8, 100)	96	(96.0)	95.3	(94.4, 96.0)
Weekly	1	(0.7)	0.1	(0.0, 0.2)	4	(4.0)	4.7	(4.0, 5.6)
Among those submitting reports, types of reports submitted[a]								
Monthly activity report	142	(97.3)	95.3	(90.7, 99.9)	92	(92.0)	89.9	(88.7, 91.0)
Monthly inventory report	100	(68.5)	61.8	(52.2, 71.5)	63	(63.0)	56.3	(54.5, 58.2)
Uses for report								
Request supplies	38	(26.0)	22.9	(15.2, 30.2)	16	(16.0)	11.5	(10.4, 12.8)
Report to supervisor	39	(26.7)	26.5	(17.9, 35.1)	65	(65.0)	60.1	(58.3, 62.0)
Report to health facility	114	(78.1)	79.2	(71.1, 87.2)	23	(23.0)	20.6	(19.1, 22.2)
Monitor number of clients seen	41	(28.1)	28.9	(20.2, 37.7)	25	(25.0)	24.7	(23.1, 26.4)
Monitor supplies	39	(26.7)	22.5	(14.6, 30.4)	23	(23.0)	21.4	(19.9, 23.0)
Plan work	45	(30.8)	25.7	(17.5, 34.0)	29	(29.0)	31.6	(29.9, 33.3)
Don't use reports	6	(4.1)	4.1	(0.5, 7.6)	3	(3.0)	4.1	(3.4, 4.9)
Other	13	(8.9)	11.1	(4.4, 17.8)	18	(18.0)	19.7	(18.3, 21.3)
Where reports submitted[a]								

Health facility	141	(96.6)	96.4	(93.0, 99.9)	97	(97.0)	96.7	(96.0, 97.3)
Partner/NGO personnel	27	(18.5)	22.0	(13.6, 30.4)	38	(38.0)	34.8	(33.0, 36.6)
SSD	6	(4.1)	3.6	(0.2, 7.0)	0	(0.0)	0.0	
Supervisor	2	(1.4)	1.1	(0.0, 3.3)	5	(5.0)	5.7	(4.9, 6.6)
TA	28	(19.2)	20.1	(14.2, 25.7)	12	(12.0)	14.0	(12.7, 15.3)
Members of the community	8	(5.5)	3.4	(0.3, 6.5)	7	(7.0)	6.2	(5.4, 7.2)
CHV keeps a copy	54	(37.0)	42.5	(32.9, 52.1)	44	(44.0)	48.9	(47.0, 50.8)
CHV does not submit reports	2	(1.4)	2.1	(0.0, 5.1)	0	(0.0)	0.0	
Don't know	2	(1.4)	2.1	(0, 5.1)	1	(1.0)	2.0	(1.5, 2.6)
Frequency for sharing reports with members of their community								
Monthly	74	(50.7)	49.7	(40.0, 59.5)	58	(59.8)	51.4	(49.5, 53.3)
Most of the months	0	(0.0)	0.0	–	2	(2.1)	1.8	(1.4, 2.4)
Sometimes	4	(2.7)	3.6	(0.0, 7.5)	2	(2.1)	1.7	(1.3, 2.3)
Rarely	1	(0.7)	0.9	(0.0, 2.5)				
Never	67	(45.9)	45.8	(36.1, 55.5)	35	(36.1)	45.1	(43.2, 47.0)
Frequency of discussing reports with other CHVs								
Always	12	(8.2)	5.1	(1.3, 8.9)	12	(12.5)	11.7	(10.5, 13.0)
Most of the time	64	(43.8)	47.8	(37.8, 57.7)	49	(51.0)	49.3	(47.4, 51.3)
Occasionally	45	(30.8)	30.2	(21.0, 39.4)	25	(26.0)	27.1	(25.4, 28.9)
Rarely	19	(13.0)	15.4	(8.3, 22.6)	7	(7.3)	9.8	(8.7, 11.0)
Never	1	(0.7)	1.4	(0.0, 4.2)	3	(3.1)	2.1	(1.6, 2.8)
Ever referred clients to health facility								
Yes	87	(58.4)	54.0	(44.4, 63.6)	62	(62.0)	66.0	(64.2, 67.8)
No	62	(41.6)	46.0	(39.2, 53.4)	38	(38.0)	34.0	(32.3, 35.8)

	n	(%)	%	(95% CI)	n	(%)	%	(95% CI)
Among those who have referred a client to the CSB, frequency of completing client referral forms								
Always	83	(95.4)	93.7	(86.9, 100)	59	(98.3)	97.8	(97.0, 98.4)
Sometimes	4	(4.6)	6.4	(0.0, 13.1)	0	(0.0)	0.0	–
Rarely	0	(0.0)	0	–	1	(1.7)	2.2	(1.6, 3.1)
Among those who have referred a client to the CSB, information included on referral form								
Reason for referral	85	(97.7)	98.5	(96.4, 100)	60	(96.8)	95.4	(94.3, 96.2)
Treatment given prior to referral	43	(49.4)	41.4	(29.2, 53.7)	11	(17.7)	15.5	(13.9, 17.2)
Treatment monitoring	4	(4.6)	3.1	(0.0, 6.6)	4	(6.5)	6.7	(5.6, 8.0)
Other	23	(26.4)	30.1	(18.0, 42.3)	23	(37.1)	40.8	(38.5, 43.1)
Among those who have referred a client to the CSB, where referral forms submitted								
CoSan member	0	(0.0)	0.0	–	1	1.6	1.7	(1.2, 2.4)
Supervisor	0	(0.0)	0.0	–	0	(0.0)	0.0	–
Health facility staff	24	(27.6)	29.9	(17.9, 41.8)	16	(25.8)	27.8	(24.8, 28.9)
Client or guardian of client	62	(71.3)	67.1	(54.8, 79.4)	44	(71.0)	71.5	(69.3, 73.5)
Other	1	(1.1)	2.5	(0.0, 6.8)	1	(1.6)	0.6	(0.3, 1.0)
Frequency of counter-referrals received about referred clients								
Always	63	(72.4)	56.8	(44.8, 68.8)	29	(47.5)	45.8	(43.4, 48.1)
Mostly	4	(4.6)	2.6	(0.0, 5.9)	3	(4.9)	4.3	(3.4, 5.4)
Sometimes	4	(4.6)	6.9	(0.2, 13.6)	3	(4.9)	4.1	(3.3, 5.2)
Rarely	7	(8.0)	9.9	(2.5, 17.3)	3	(4.9)	6.9	(5.8, 8.1)
Never	21	(24.1)	23.8	(13.2, 34.3)	23	(37.7)	39.0	(36.7, 41.3)

ᵃ Total can exceed 100% as could select more than one response

Table 13. Transportation methods available for clients referred to the primary health care facility, by CHV type

| | c-IMCI-trained CHVs (n=149) | | | | RH-trained CHVs (n=100) | | | |
| | Unweighted | | Weighted | | Unweighted | | Weighted | |
	n	(%)	%	(95% CI)	n	(%)	%	(95% CI)
Foot	128	(85.9)	83.1	(75.6, 90.6)	72	(72.0)	69.5	(67.8, 71.3)
Bicycle	8	(5.4)	6.1	(1.4, 10.9)	3	(3.0)	2.0	(1.6, 2.6)
Motorcycle	0	(0.0)	0.0	–	0	(0.0)	0.0	–
Taxi	50	(33.6)	37.5	(28.2, 46.8)	28	(28.0)	36.1	(34.3, 37.9)
Bus	35	(23.5)	27.2	(18.2, 36.2)	32	(32.0)	29.5	(27.8, 31.2)
Bullock cart	9	(6.0)	7.6	(2.0, 13.3)	7	(7.0)	4.7	(3.9, 5.5)
Boat	21	(14.1)	17.9	(10.6, 25.2)	16	(16.0)	20.1	(18.7, 21.7)
Filanjana[a]	29	(19.5)	18.2	(11.1, 25.4)	20	(20.0)	17.9	(16.5, 19.4)
Ambulance	0	(0.0)	0.0	–	0	(0.0)	0.0	–
Other	40	(26.8)	28.3	(19.6, 37.1)	34	(34.0)	34.4	(32.6, 36.2)

[a]*A traditional Malagasy palanquin*

Table 14. Case management knowledge among c-IMCI-trained CHVs (n=149)

	Weighted %	(95% CI)
Can name 3 danger signs for a child <5 years requiring immediate referral to a health center		
Yes	88.4	(82.0, 94.9)
No	11.6	(5.1, 18.0)
Knows the correct rapid respiratory rate criteria for classifying a 3 year old child with pneumonia		
Yes	90.6	(84.6, 96.6)
No	9.4	(3.4, 15.4)
Knows the correct treatment for a child of 8 months with a rapid respiratory rate but no additional danger signs		
Yes	74.0	(65.2, 82.7)
No	26.0	(17.3, 34.8)
Knows at least 3 signs for severe diarrhea in a 3 year old requiring immediate referral to a health center		
Yes	87.8	(81.4, 94.1)
No	12.2	(5.8, 18.6)
Knows to administer a rapid diagnostic test for an 11 month old with fever and no danger signs		
Yes	84.7	(77.3, 92.2)
No	15.3	(7.8, 22.7)
Knows to refer a 3 year old child with nuchal rigidity immediately to the health facility		
Yes	97.7	(94.6, 100.0)
No	2.3	(0.0, 5.4)
Can list 2 danger signs associated with malnutrition requiring immediate referral to a health facility		
Yes	64.1	(54.9, 73.4)
No	35.9	(26.6, 45.1)
Can name 3 effective ways to prevent illness in children <5 years		
Yes	78.0	(70.0, 86.0)
No	22.0	(14.0, 30.0)
Knows to treat a 2 year old child with fever, no danger signs and a postitive RDT with an ACT		
Yes	74.4	(65.9, 82.9)
No	25.6	(17.1, 34.1)
Knows to refer a child with a fever and a negative RDT test result to the nearest health facility for care		

Yes	77.6	(69.4, 85.7)
No	22.4	(14.3, 30.6)
Knows to refer a child to the nearest health facility if the child has a fever and no RDTs are available (stock out)		
Yes	84.3	(77.4, 91.2)
No	15.7	(8.7, 22.6)
Correctly reads an invalid RDT result (no control line) and knows to repeat the test		
Yes	64.3	(54.9, 73.6)
No	35.7	(26.4, 45.1)

Table 15. DMPA knowledge among RH-trained CHVs (n=100)

	Weighted %	(95% CI)
Knows not to give DPMA to non-menstruating woman attending initial, family planning visit		
Yes	93.0	(91.9, 93.9)
No	7.0	(6.1, 8.1)
Can list 2 conditions to exclude a pregnancy among non-menstruating women before providing DMPA		
Yes	76.8	(75.2, 78.4)
No	23.2	(21.6, 24.8)
Can describe steps before administering DMPA (clean the injection site with alcohol or clean water and determine the exact injection zone)		
Yes	77.6	(76.0, 79.2)
No	22.4	(20.9, 24.0)
Can describe steps needed if the needle hits a blood vessel when administering DMPA		
Yes	91.0	(89.8, 92.0)
No	9.1	(8.0, 10.2)
Can list 4 disadvantages or side effects of DMPA		
Yes	66.6	(64.8, 68.4)
No	33.4	(31.6, 35.2)
Can list 2 signs for women using DMPA that should prompt referral to primary health center		
Yes	79.0	(77.4, 80.5)
No	21.0	(19.5, 22.6)
Knows that DMPA is effective for 12 weeks		
Yes	98.1	(97.5, 98.5)
No	1.9	(1.5, 2.5)
Knows that 16 weeks after initial injection is too late for second injection		
Yes	96.7	(95.9, 97.3)
No	3.3	(2.7, 4.1)
Knows to refer client who returns too late for second injection to health center to avoid unwanted pregnancy		
Yes	57.1	(55.2, 58.9)
No	43.0	(41.1, 44.8)

Table 16. Characteristics of ill-children included in assessment (n=745)

Characteristic	Value
Median age in months (range)	13 (0–59)
Sex, female	52%
Chief complaint	
Cough	64%
Fever	37%
Diarrhea	25%
Other	17%
Illness with danger signs requiring referral	22%
Required life-saving treatment on site for uncomplicated illness (ACT, CTM, ORS)[a]	38%

[a]*ACT: artemisinin-based combination therapy; CTM: cotrimoxazole; ORS: oral rehydration solution*

Table 17. Proportion of children classified correctly by CHVs (n=745)

Classification	Total number classified by gold standard	% Classified Correctly by CHVs	95% CI
Severe diarrhea	23	41%	15–68
Uncomplicated diarrhea	145	55%	44–66
Severe respiratory illness	3	43%	18–68
Uncomplicated pneumonia	101	39%	26–51
Severe febrile illness	6	26%	0–82
Uncomplicated malaria	31	67%	47–86
Illness with danger signs	160	73%	65–82
Nutrition status	745	83%	78–89
Severe malnutrition	31	68%	44–92

Table 18. Proportion of children treated correctly for IMCI illnesses by CHVs

Classification	Total number treated by gold standard	% Treated Correctly by CHVs	95% CI
Severe diarrhea	23	74%	(50.2, 97.0)
Uncomplicated diarrhea	145	44%	(32.1, 56.8)
Severe respiratory illness	27	69%	(47.3, 91.2)
Uncomplicated pneumonia	101	50%	(36.2, 65.8)
Cough	288	42%	(32.3, 52.7)
Severe febrile illness	13	61%	(30.4, 92.0)
Uncomplicated malaria	30	60%	(36.7, 84.3)
Other febrile illness	177	53%	(42.9, 65.2)
Illness requiring referral[a]	252	68%	(60.0, 76.5)
Severe malnutrition	31	78%	(59.8, 98.2)
Illness requiring lifesaving treatment on-site[b]	256	53%	(43.6, 63.1)

[a]Illnesses that required referral included: severe malnutrition, severe diarrhea, severe febrile illness, severe respiratory illness, presence of any danger signs, disease identification other than fever, respiratory illness or diarrhea
[b]c-IMCI treatable illness requiring lifesaving treatment on-site: uncomplicated diarrhea, pneumonia and/or fever

Table 19. Performance Score for c-IMCI-trained CHVs

Statistic	Value	95% CI
Number of ill-child assessments[a]	622	NA
Mean performance Score	75.1%	(72.3, 77.8)
Median performance score	79%	NA
Range of performance scores	6.25%–100%	NA

[a]Excludes children with chief complaints of non-cIMCI diagnoses (for example, skin rash)

Table 20. Correlates of IMCI-trained CHV comprehensive tasks performance score (0.0-1.0) from linear regression

	Crude		Adjusted[a]	
	β	(p value)	β	(p value)
Gender of CHV				
Female	0.04	(0.2)		
Male	1.0			
Age of CHV	0.0004	(0.79)		
Years of education completed	0.01	(0.08)	0.01	(0.5)
Distance from health facility >20km				
Yes	-0.002	(0.03)	-0.08	(0.05)
No	1.0			
Duration of experience as CHV (months)	0.001	(0.12)		
Number of children seen in previous month	0.004	(0.39)		
Number of children seen in previous week	0.01	(0.15)		
Trained as CHV by MOH/UNICEF				
Yes	-0.034	(0.20)		
No	1.0			
Received refresher training after IMCI training				
Yes	5.0	(0.18)		
No or do not know				
Experienced stock out of supplies or medications				
Yes	-0.09	(0.8)		
No				
Number of supervision visits in previous 12 months				
0	-0.02	(0.4)		
1-5	-0.01	(0.08)	-0.08	(0.05)
6-10	0.05	(0.5)		
>12	0.1	(0.3)		
Number of reported responsibilities[b]	0.016	(0.0006)	0.015	(0.0005)
IMCI knowledge score[c]	0.05	(0.0001)	0.03	(0.0008)
Age of child (in months)	0.0005	(0.38)		
Gender of child				
Female	-0.02	(0.24)		

Male	1.0			
Chief complaint: Cough				
Yes	-0.07	(0.0008)	-0.06	(0.004)
No	1.0			
Chief complaint: Diarrhea				
Yes	-0.02	(0.3)	-0.05	(0.008)
No	1.0			
Chief complaint: Fever				
Yes	-0.1	(0.0001)		
No	1.0			
Cough assessment performed				
Yes	0.07	(0.003)		
No	1.0			
Diarrhea assessment performed				
Yes	0.04	(0.03)		
No	1.0			
Fever assessment performed				
Yes	0.07	(0.002)		
No	1.0			
Number of IMCI complaints	-0.05	(0.001)		

[a]Adjusted for all variables in the column.
[b] Based on CHV self-reported responsibilities as listed in Table 6.
[c] IMCI knowledge score based on responses in Figure 1 and Table 14.

Table 21. Activities by RH-trained CHV during client encounters (N=500)

Activities	%	(95% CI)
Part 1: welcome and obtain basic information		
Wears blouse / badge		
Yes	89.2	(88.7, 89.7)
No	10.8	(10.3, 11.3)
Welcomes the client		
Yes	98.8	(98.6, 99.0)
No	1.2	(1.0, 1.4)
Assures the client about the confidentiality and privacy of the session		
Yes	40.8	(39.9, 41.6)
No	59.2	(58.4, 60.1)
Inquires about the client's residence		
Yes	61.9	(61.1, 62.7)
No	38.1	(37.3, 38.9)
Inquires about client's age		
Yes	59.4	(58.5, 60.2)
No	40.6	(39.8, 41.5)
Helps the client to express needs		
Yes	77.9	(77.2, 78.6)
No	22.1	(21.4, 22.8)
Uses documents for counseling on available contraceptive methods		
Yes	96.0	(95.7, 96.3)
No	4.0	(3.7, 4.4)
Presents at least one advantage for the method		
Condoms	90.5	(90.0, 91.0)
CycleBeads (method based on fertility awareness)	79.7	(79.0, 80.4)
Exclusive breastfeeding	53.2	(52.3, 54.0)
DMPA	95.8	(95.5, 96.2)
Contraceptive implant	55.7	(54.9, 56.5)
Combination oral contraception (COC)	94.3	(93.9, 94.7)
Progestin-only pill	61.3	(60.4, 62.1)
Intrauterine device (IUD)	56.0	(55.2, 56.9)
Tubal ligation	56.8	(56.0, 57.6)
Vasectomy	54.2	(53.3, 55.0)
Encourages client or couple to make an informed choice		
Yes	89.1	(88.6, 89.6)

No	10.9	(10.4, 11.4)

Part 2: assess eligibility and provide counseling

Asks sufficient questions from checklist to be able to rule out pregnancy

Yes	68.9	(68.2, 69.7)
No	31.1	(30.3, 31.9)

Does not suspect pregnancy among those with ≥1 factor from checklist ruling out pregnancy (N=322)

Yes	96.3	(96.0, 96.6)
No	3.7	(3.4, 4.0)

Asks all necessary questions to assess contraindications for oral contraception use among those expressing interest in this method (N=63)

Yes	40.6	(38.1, 43.0)
No	59.5	(57.0, 61.9)

Properly classifies eligibility for oral contraception use among those expressing interest in this method (N= 63)

Yes (eligible with no contraindications reported or ineligible with ≥1 contraindication reported)	91.3	(89.6, 92.8)
No (eligible with ≥1 contraindication reported or ineligible with no contraindications reported)	8.7	(7.2, 10.5)

Provides adequate counseling messages on oral contraception use (i.e., describes ≥1 method advantage and disadvantage, instructions on daily pill use and instructions on missed pills) among women who choose and are eligible for the method (N=43)

Yes	12.8	(10.9, 14.9)
No	87.3	(85.1, 89.1)

Asks all necessary questions to assess contraindications for DMPA use among those choosing this method (N=315)

Yes	83.0	(82.2, 83.8)
No	17.0	(16.2, 17.8)

Properly classifies eligibility for DMPA use among those choosing this method (N=315)

Yes (eligible with no contraindications reported or ineligible with ≥1 contraindication reported)	93.0	(92.4, 93.5)
No (eligible with ≥1 contraindication reported or ineligible with no contraindications reported)	7.0	(6.5, 7.6)

Provides adequate counseling messages on DMPA use (e.g., describes ≥1 method advantage and disadvantage and instructs that injectable is effective for three months) to women who choose and are eligible for the method (N=307)

Yes	43.0	(42.0, 44.1)

No	57.0	(55.9, 58.1)

Table 22. Correlates of RH-trained CHV comprehensive tasks performance score from linear regression[a]

	Crude		Adjusted[b]	
	β	(95% CI)	β	(95% CI)
Gender				
Male	1.5	(-4.9, 7.9)		
Female	1.0			
Age	-0.2	(-0.6, 0.2)		
Years of education completed	1.7	(0.3, 3.0)	1.8	(0.5, 3.1)
Within 1 hour or 5 kilometers of assigned primary health center				
Yes	-2.3	(-9.1, 4.4)		
No	1.0			
Duration of experience as CHV	0.1	(-0.1, 0.4)		
Experience as a traditional healer, midwife or community retailer				
Yes	-2.8	(-12.6, 7.0)		
No	1.0			
Approximate weekly work hours as CHV	0.3	(-0.1, 0.6)	0.3	(0.0, 0.6)
Number of women provided contraceptive services to last month	0.1	(-0.1, 0.3)		
Selected by community members as CHV				
Yes	-1.2	(-9.6, 7.3)		
No	1.0			
Understands CHV role includes contraception counseling and provision				
Yes	-0.1	(-10.6, 10.4)		
No	1.0			
Trained as CHV by both nongovernmental organization and head of primary health center				
Yes	1.3	(-5.9, 8.4)		
No	1.0			
Received refresher training after initial family planning training				
Yes	10.5	(3.9, 17.1)	13.2	(6.7, 19.7)
No or do not know				
Uses family planning patient forms and has continued supply of stock				
Yes	-4.0	(-11.1, 3.0)		

No

Provided services in presence of supervisor at site or at primary health center during last supervision

    Yes   0.5   (-5.9, 7.0)

    No

Received performance evaluation in prior 12 months with direct observation at last evaluation

    Yes   4.0   (-2.9, 10.9)

    No

Receives ≥3 benefits from assigned district for work as CHV

    Yes   -0.4   (-10.8, 9.9)

    No

Receives ≥3 benefits from community for work as CHV

    Yes   13.9   (4.5, 23.2)

    No

Refers patients to primary health center and always or most of the time receives feedback on referrals

    Yes   0.1   (-6.7, 7.0)

    No

Opportunities for promotion or progression

    Yes   5.8   (-1.6, 13.2)

    No

Supervisor checked patient registers and monthly report at last evaluation

    Yes   -1.5   (-8.0, 5.0)

    No

DMPA knowledge[c]   3.6   (1.5, 5.6)

[a]*Comprehensive performance score based on all factors listed in Table 22.*
[b]*Adjusted for all variables in the column.*
[c]*DMPA knowledge score (0-9) based on responses in Table 14.*

Table 23. Correlates of RH-trained CHV critical tasks performance score from linear regression[a]

	Crude		Adjusted[b]	
	β	(95% CI)	β	(95% CI)
Gender				
Male	2.0	(-2.5, 6.6)		
Female	1.0			
Age	-0.1	(-0.4, 0.1)		
Years of education completed	1.0	(-0.0, 1.9)	1.2	(0.3, 2.2)
Within 1 hour or 5 kilometers of assigned primary health center				
Yes	-3.5	(-8.3, 1.3)		
No	1.0			
Duration of experience as CHV	0.0	(-0.1, 0.2)		
Experience as a traditional healer, midwife or community retailer				
Yes	1.2	(-5.7, 8.2)		
No	1.0			
Approximate weekly work hours as CHV	0.1	(-0.1, 0.4)		
Number of women provided contraceptive services to last month	0.0	(-0.1, 0.2)		
Selected by community members as CHV				
Yes	-1.7	(-7.7, 4.3)		
No	1.0			
Understands CHV role includes contraception counseling and provision				
Yes	-0.1	(-7.6, 7.4)		
No	1.0			
Trained as CHV by both nongovernmental organization and head of primary health center				
Yes	-4.5	(-9.5, 0.5)	-6.0	(-10.9, -1.1)
No	1.0			
Received refresher training after initial family planning training				
Yes	3.8	(-1.1, 8.7)	5.2	(0.5, 10.0)
No or do not know	1.0			
Uses family planning patient forms and has continued supply of stock				
Yes	-4.6	(-9.6, 0.4)		

No	1.0	
Provided services in presence of supervisor at site or at primary health center during last supervision		
Yes	1.7	(-2.8, 6.3)
No	1.0	
Received performance evaluation in prior 12 months with direct observation at last evaluation		
Yes	-0.1	(-5.1, 4.8)
No	1.0	
Receives ≥3 benefits from assigned district for work as CHV		
Yes	-0.8	(-8.1, 6.6)
No	1.0	
Receives ≥3 benefits from community for work as CHV		
Yes	5.7	(-1.2, 12.5)
No	1.0	
Refers patients to primary health center and always or most of the time receives feedback on referrals		
Yes	1.3	(-3.6, 6.1)
No	1.0	
Opportunities for promotion or progression		
Yes	1.6	(-3.7, 6.9)
No	1.0	
Supervisor checked patient registers and monthly report at last evaluation		
Yes	-0.2	(-4.8, 4.5)
No	1.0	
DMPA knowledge[c]	2.5	(1.0, 3.9)

[a]*Critical tasks performance score based on "Encourages client to make an informed choice" and all variables in Part 2 of Table 21.*
[b]*Adjusted for all variables in the column.*
[c]*DMPA knowledge score (0-9) based on responses in Table 14.*

FIGURES
Figure 1 Map of Selected Evaluation Sites
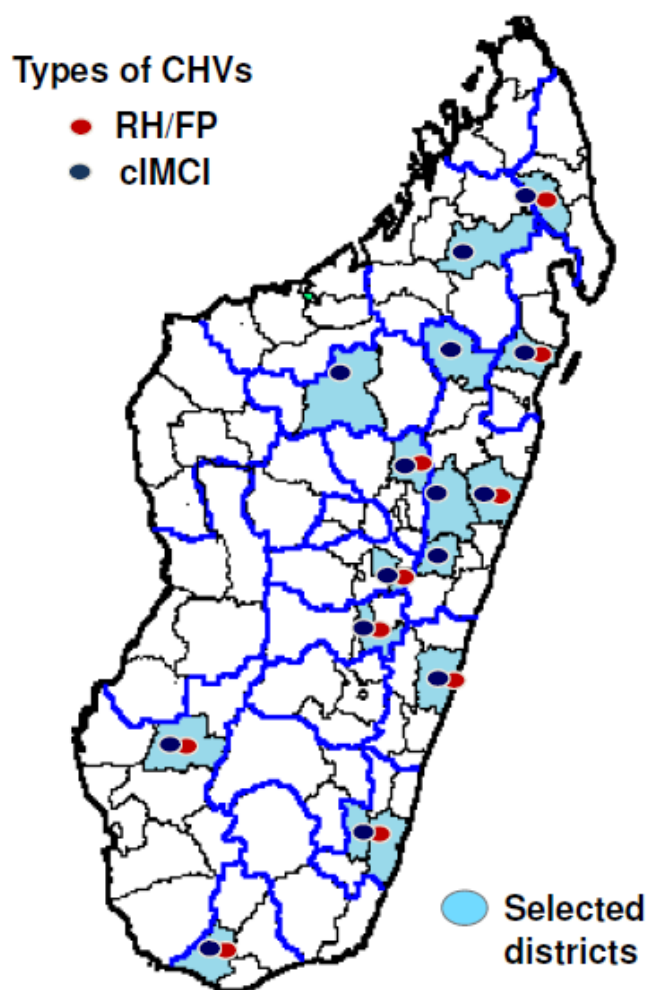
Figure 2. c-IMCI CHV knowledge assessment scores, by question*

CHV Knowledge Assessment Scores
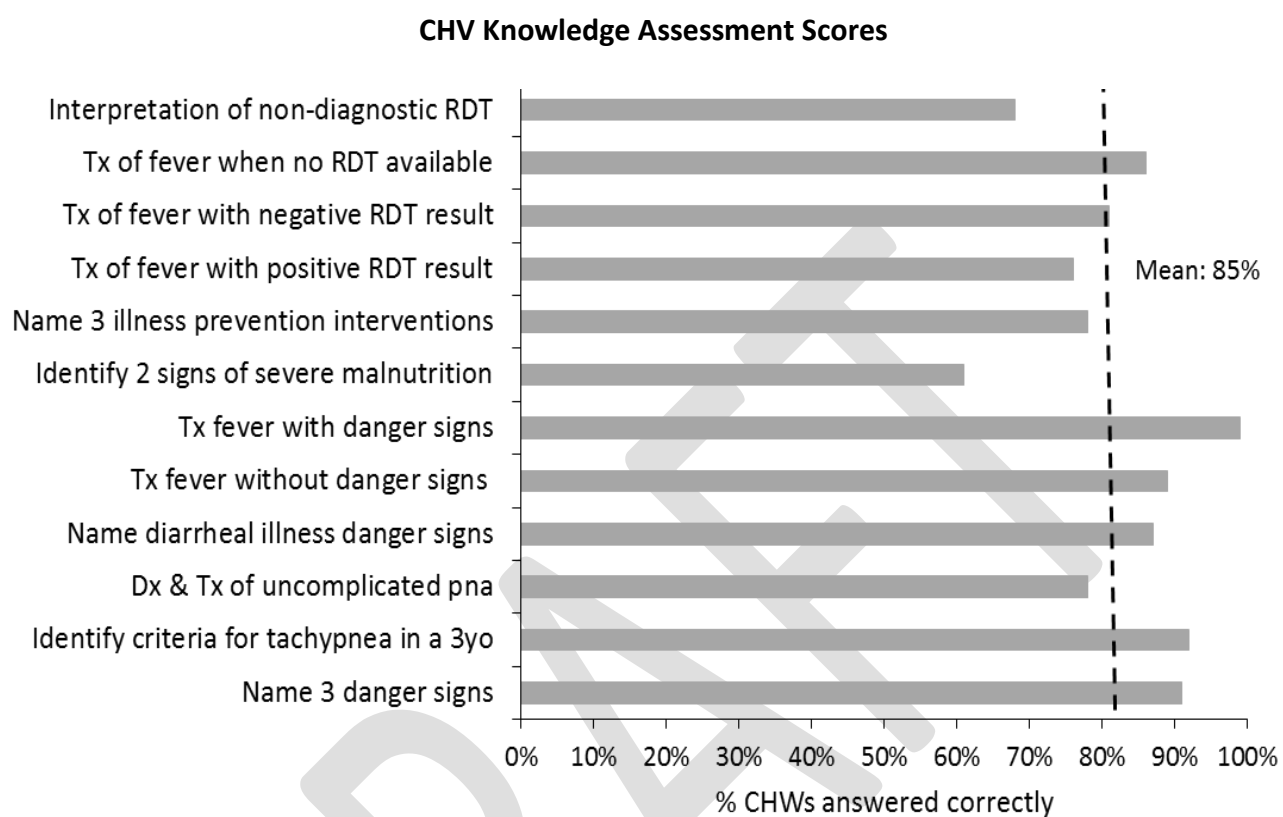
RDT: malaria rapid diagnostic test; Tx: treatment; Dx: diagnosis; yo: year old

*Note that only those CHVs trained in performing RDTs were asked RDT-related questions

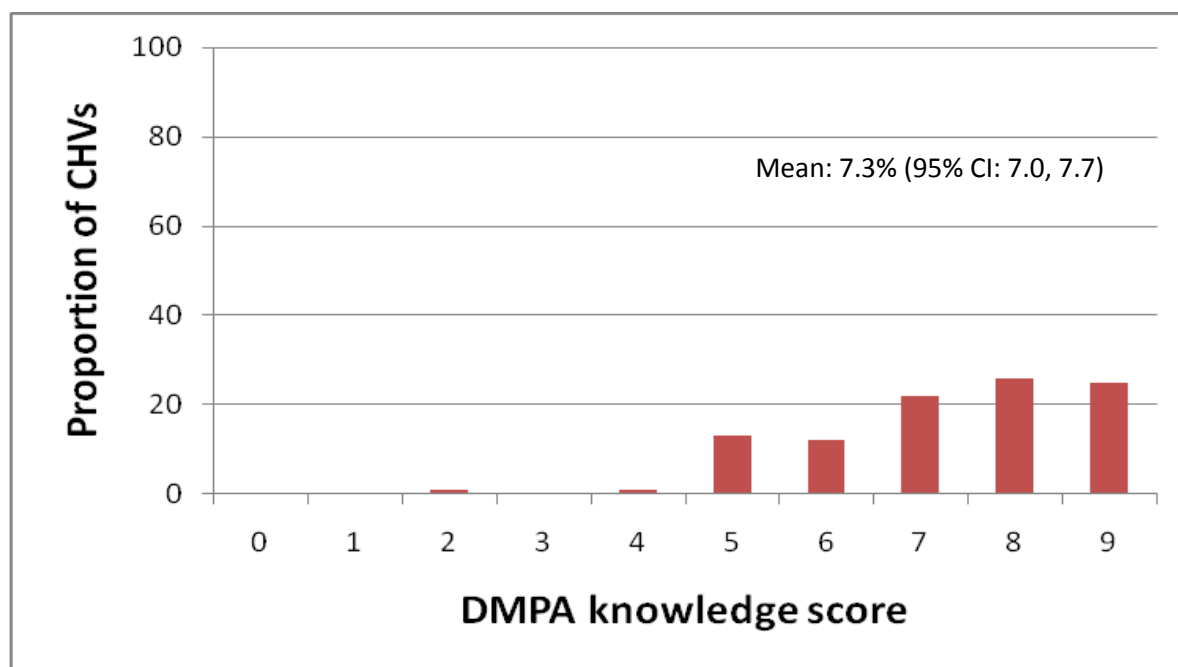Figure 3. DMPA knowledge score among RH-trained CHVs (N=100)

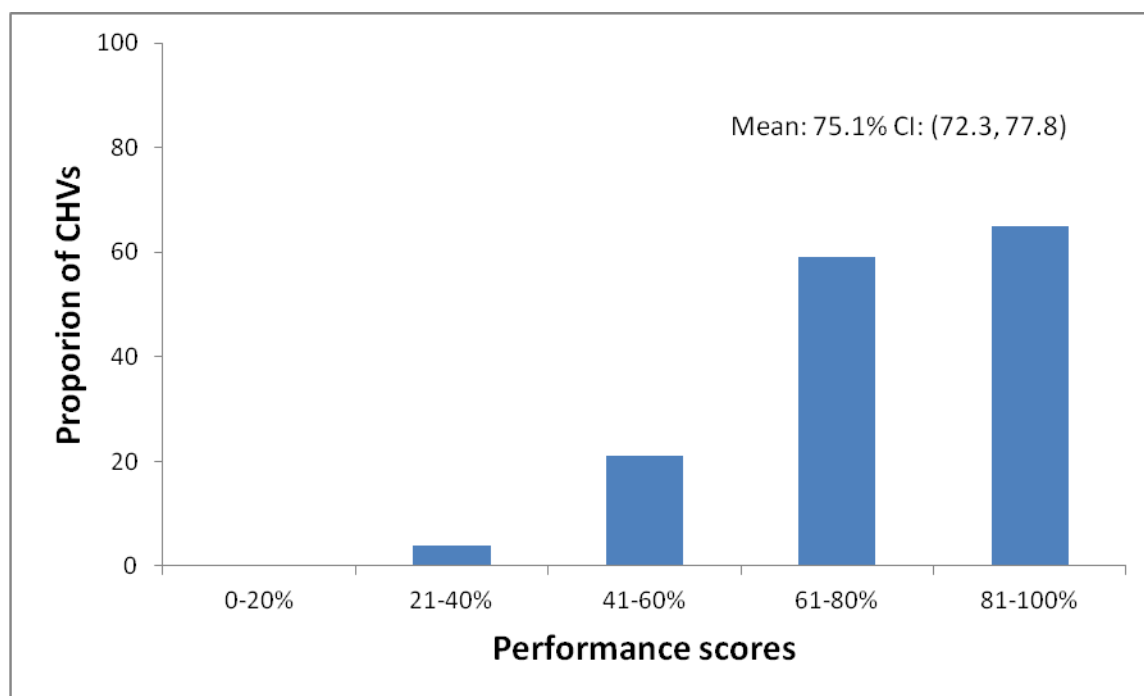Figure 4. Performance scores among CHVs trained in c-IMCI (n=149)

Figure 5a. c-IMCI CHV performance scores for the assessment of danger signs
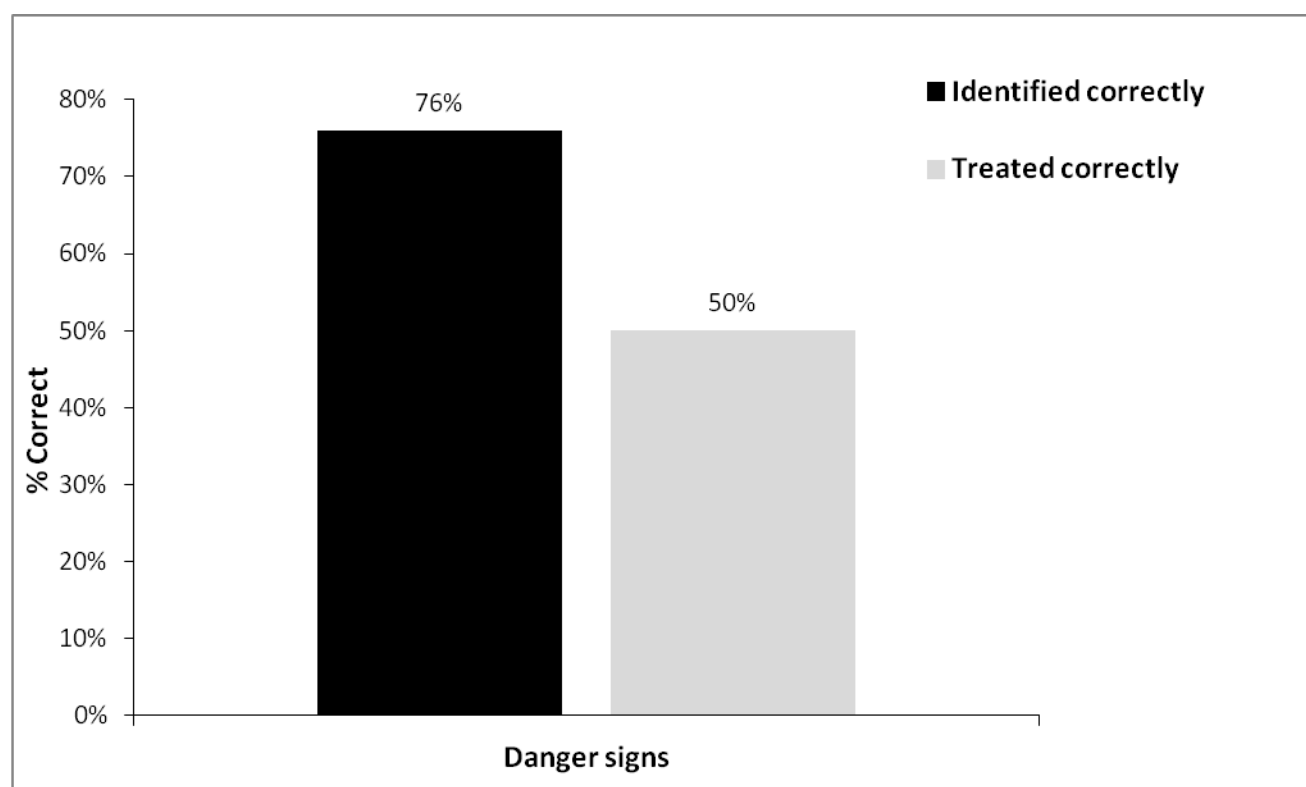
Figure 5b. c-IMCI CHV performance scores for the assessment of respiratory illness
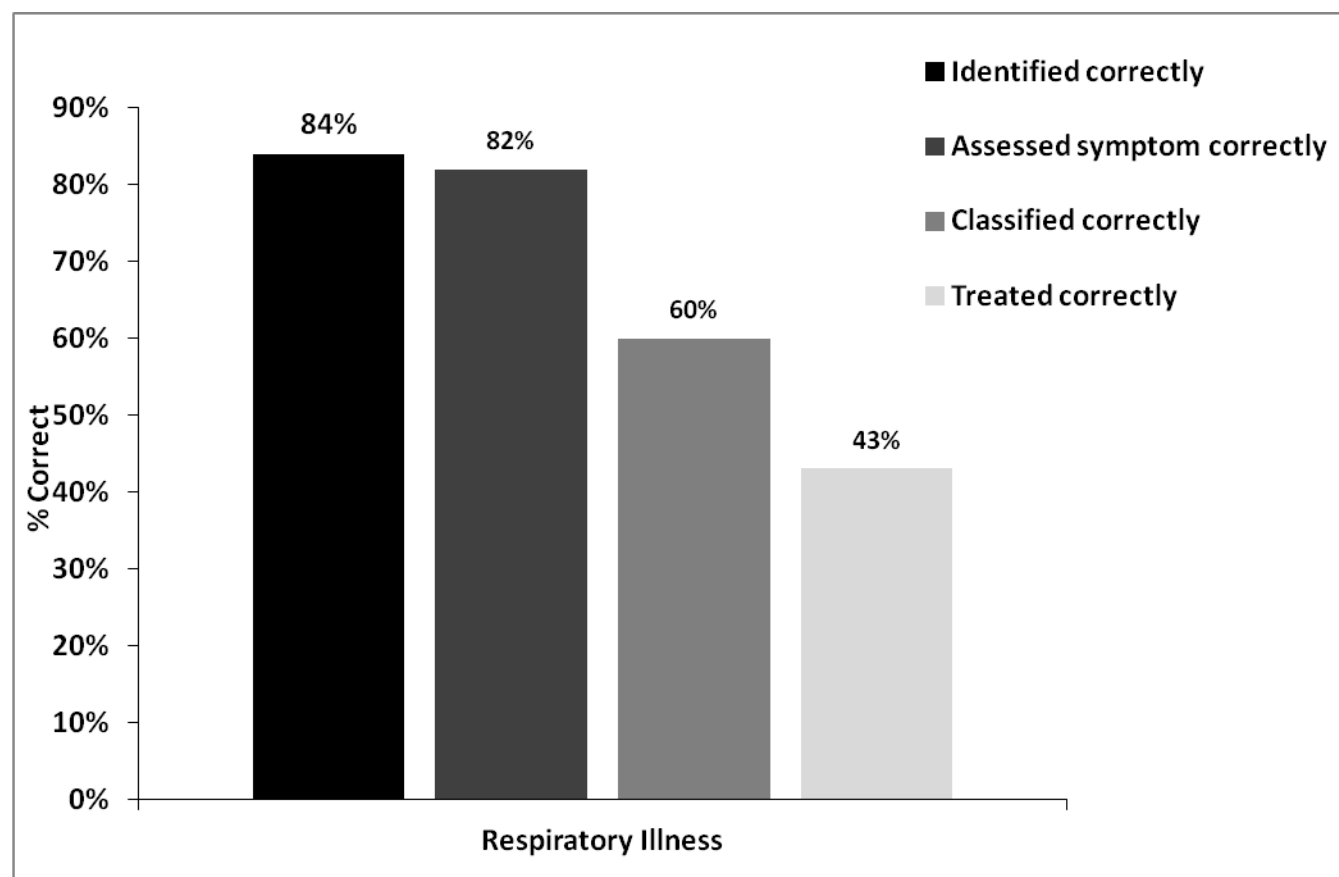
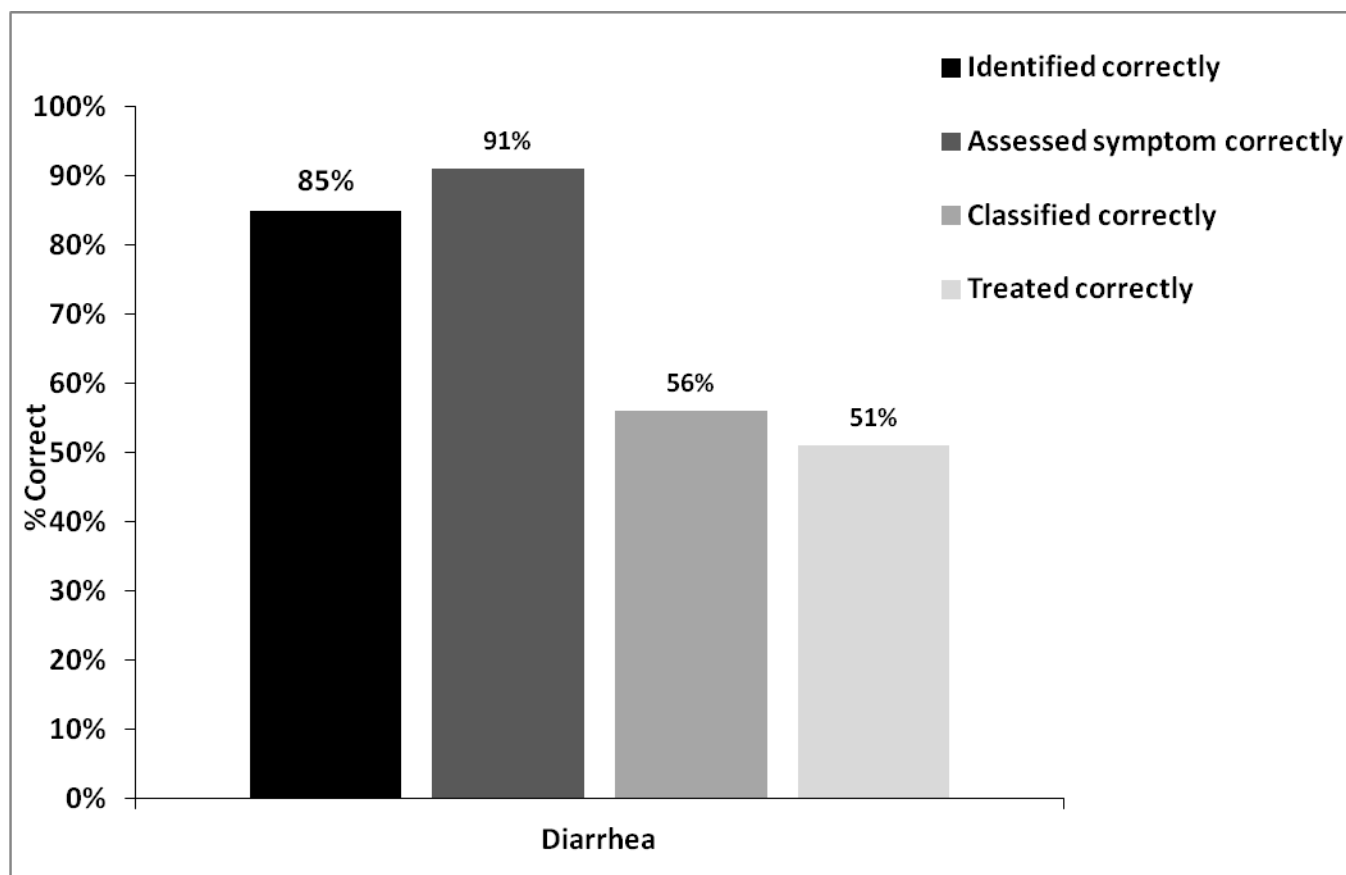Figure 5c. c-IMCI CHV Performance scores for the assessment of diarrheal illness

Figure 5d. CHV performance scores for the assessment of febrile illness in children under five years of age
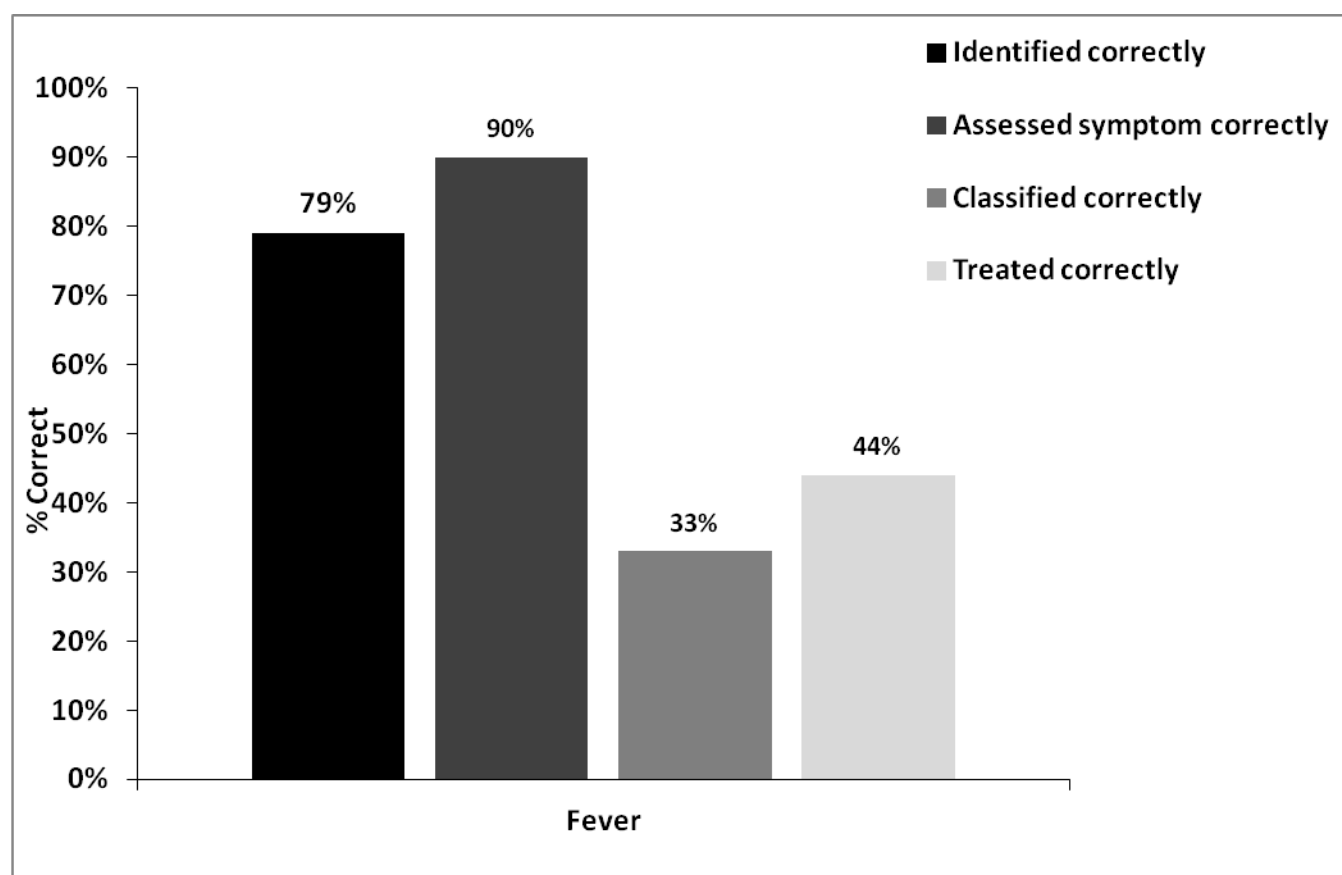
Figure 5e. CHV performance scores for the assessment of nutrition status in children under five years of age
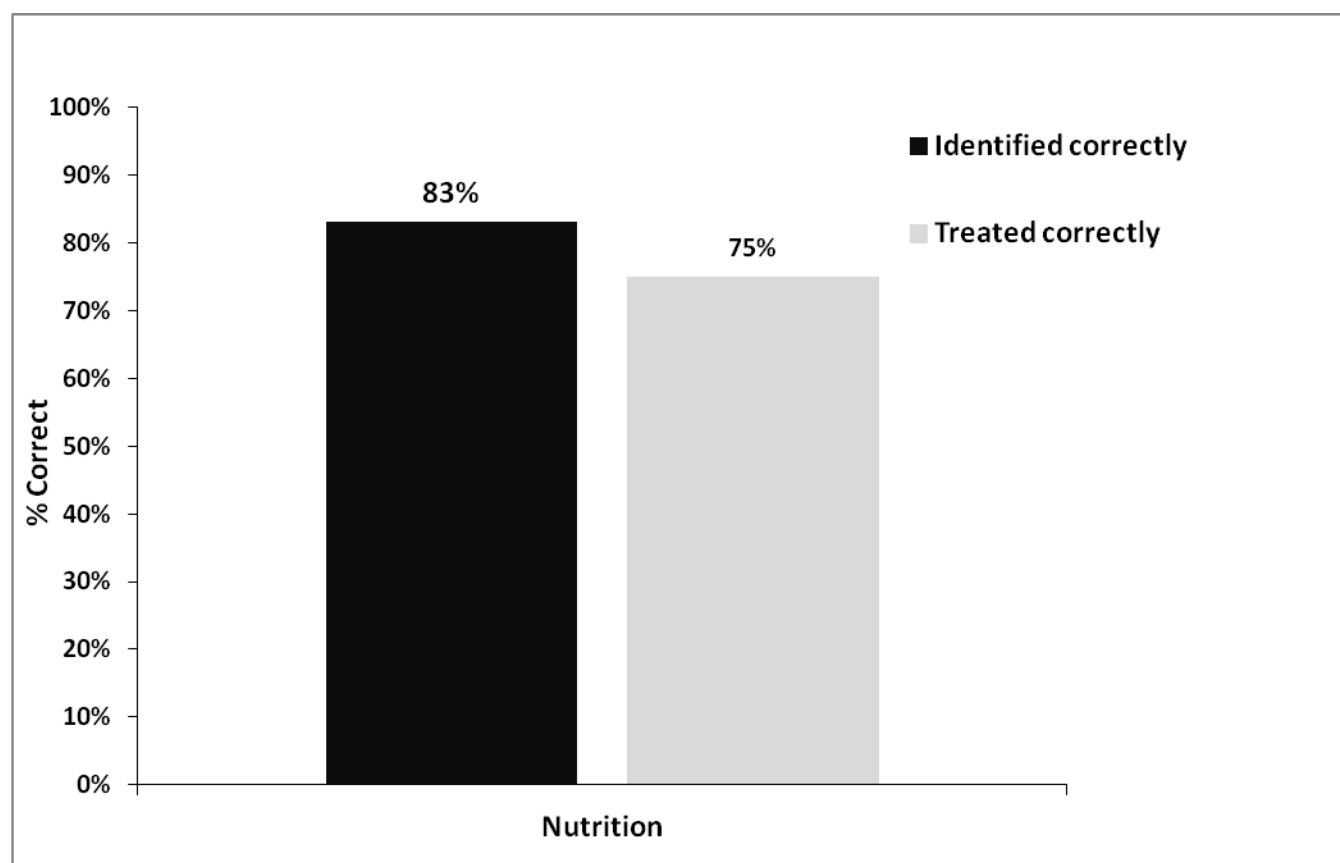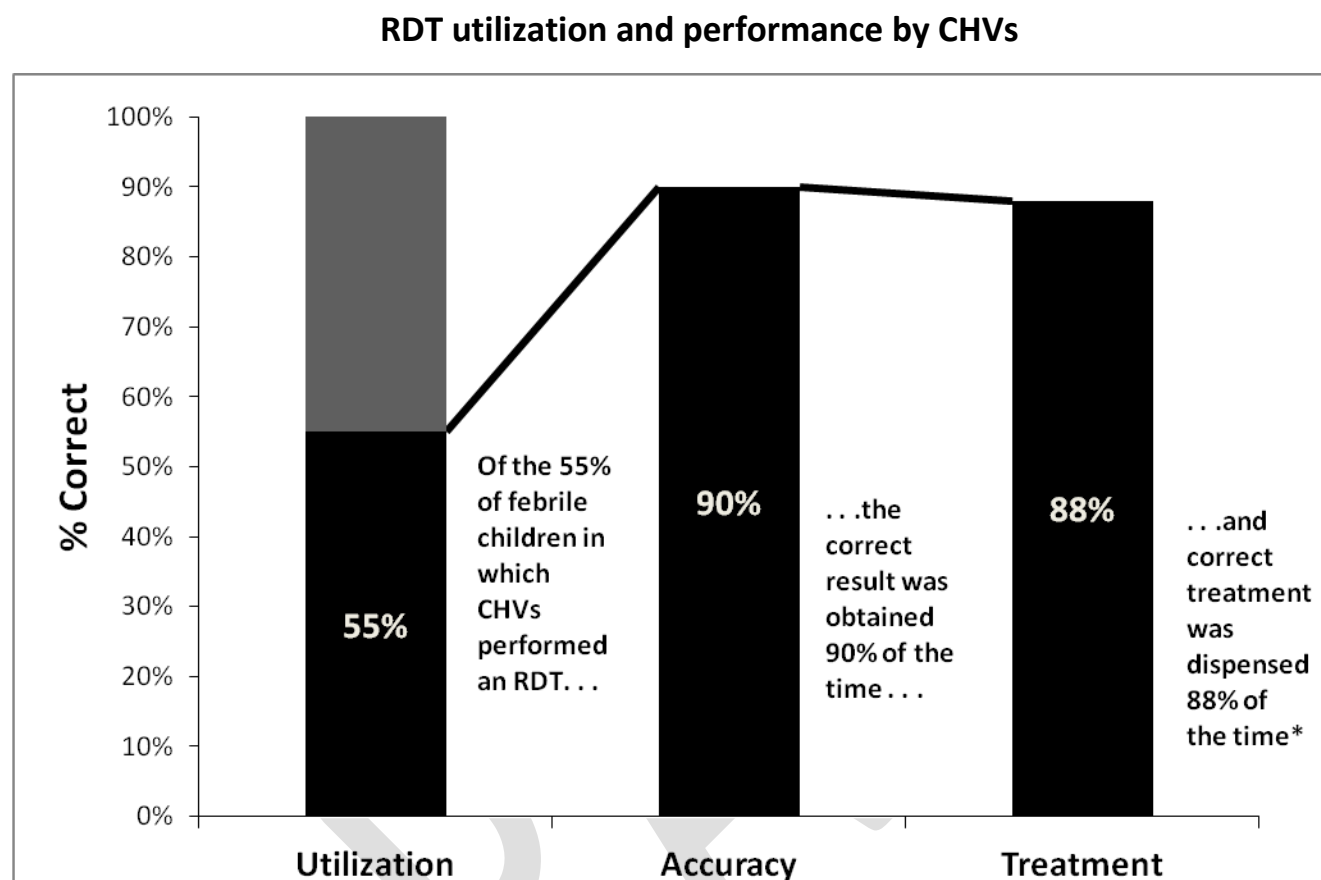
Figure 6. CHV use of malaria rapid diagnostic tests (RDTs) and performance

RDT utilization and performance by CHVs

*Artemisinin-based combination drugs (ACTs) given in cases of positive rapid diagnostic test for malaria (RDT) and no ACT given in case of negative RDT.
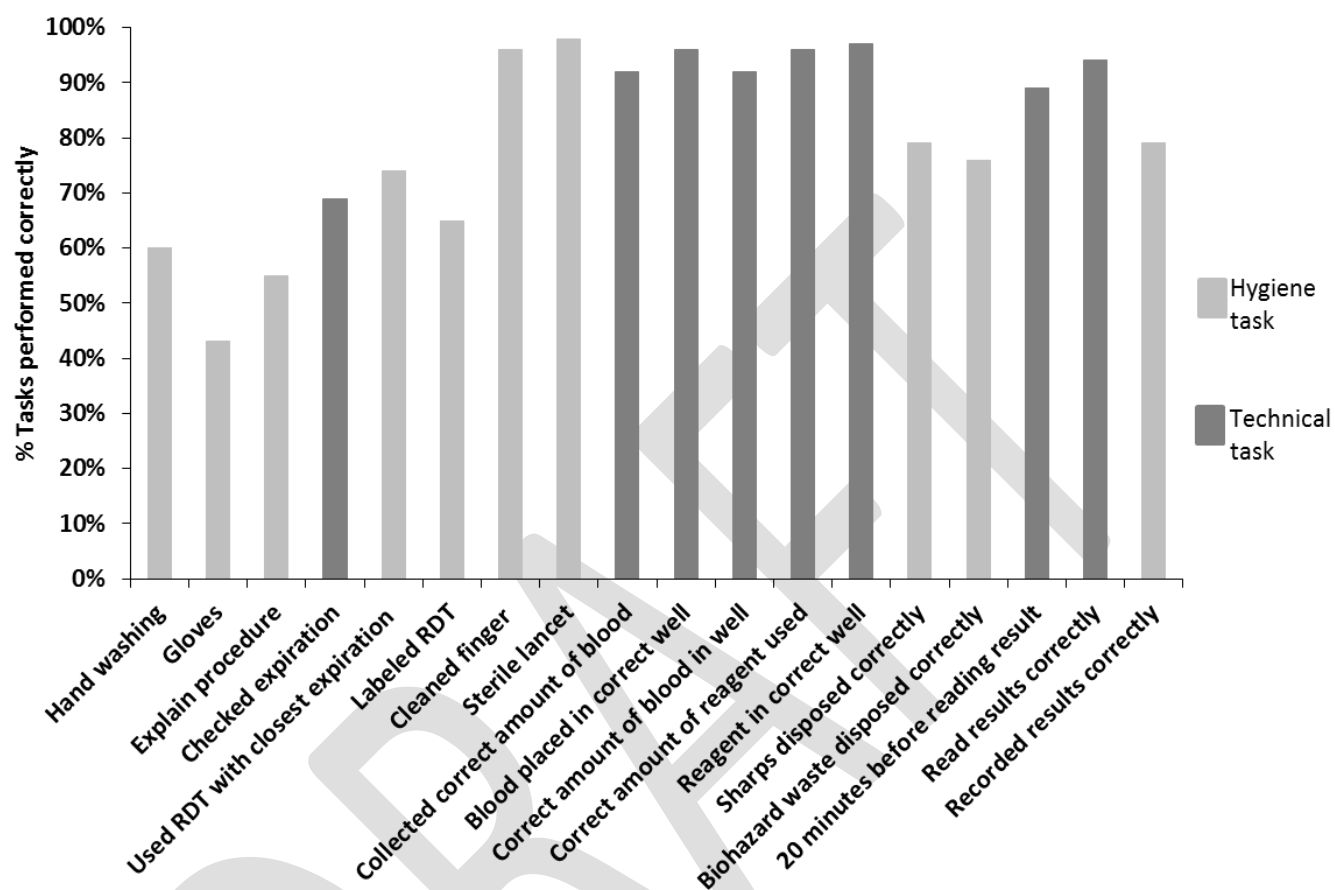
Figure 8a. Comprehensive performance score among RH-trained CHVs (N=100)
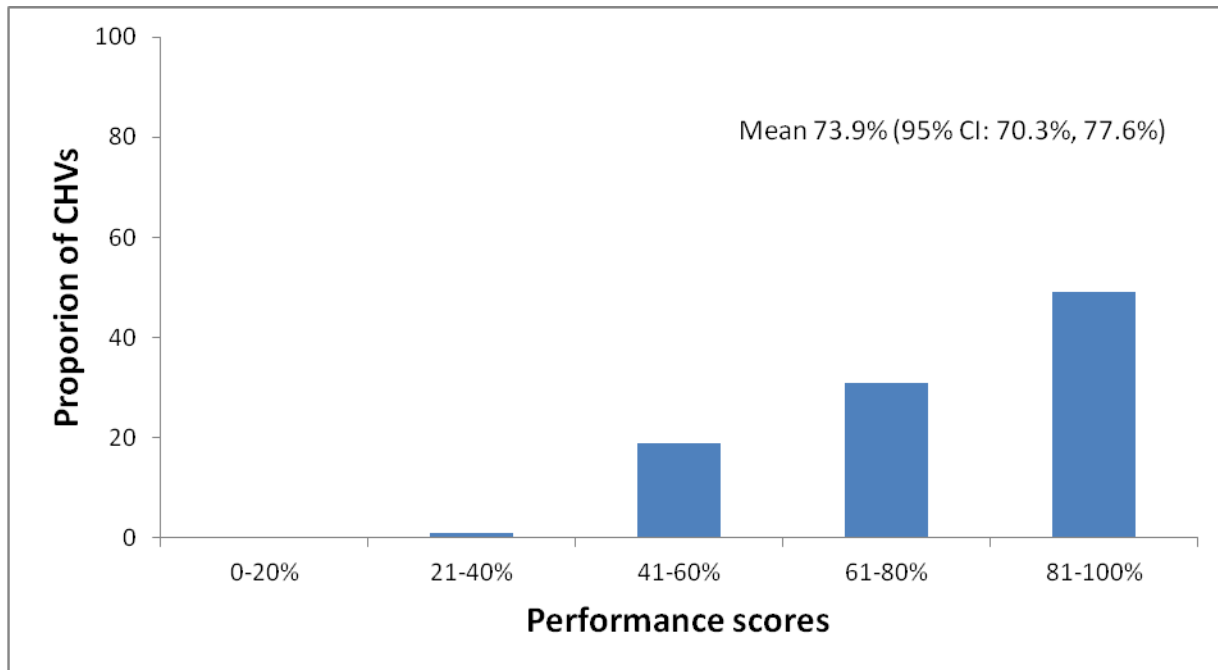
Figure 8b. Critical tasks performance score among RH-trained CHVs (N=100)
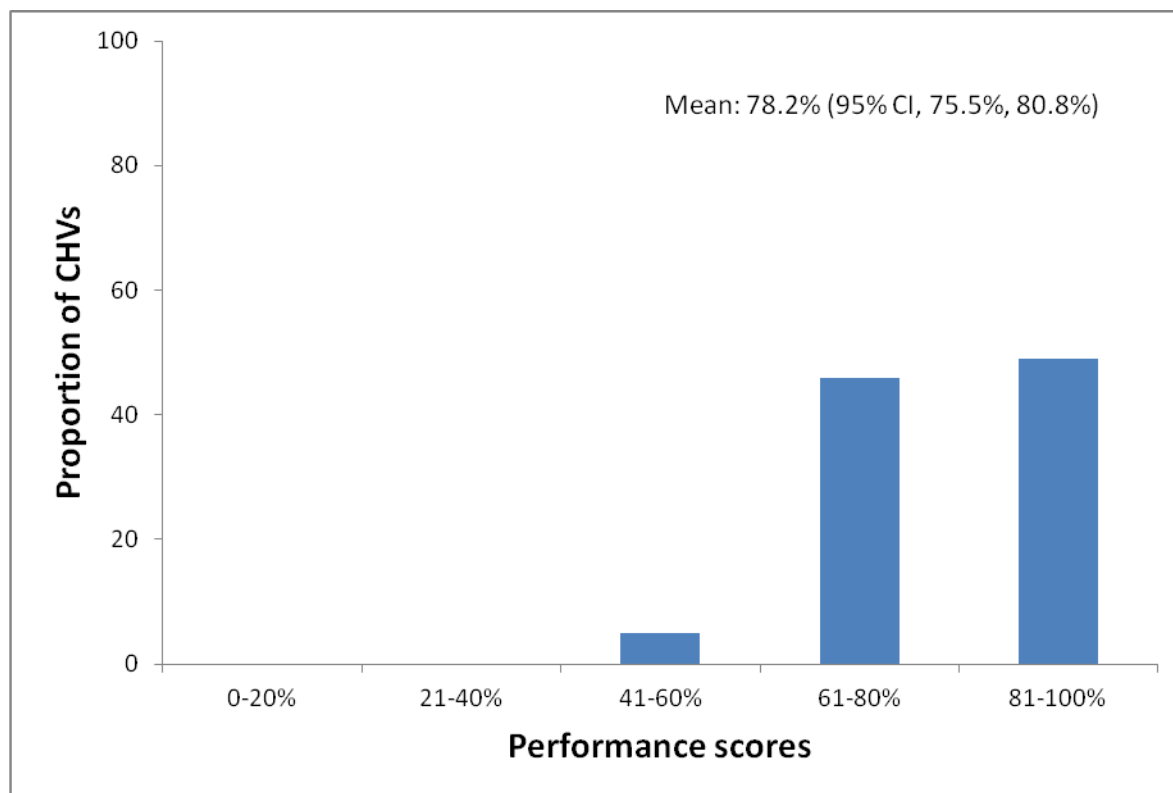
APPENDIX

Figure A1. c-IMCI Algorithms used by CHVs in Madagascar to evaluate ill-children: assess nutritional status, identify chief complaint and assess danger signs

Figure A2. Algorithm for evaluation of children with diarrheal illness

Figure A3. Algorithm for evaluation of children with respiratory illness

*Rapid respiratory rate criteria: age 2-12mo, $\geq$ 50; age >12 mo, $\geq$40
**Age <6 months: exclusive breastfeeding, $\geq$6 months: homemade cough syrup TID

Figure A4. Algorithm for evaluation of children with fever
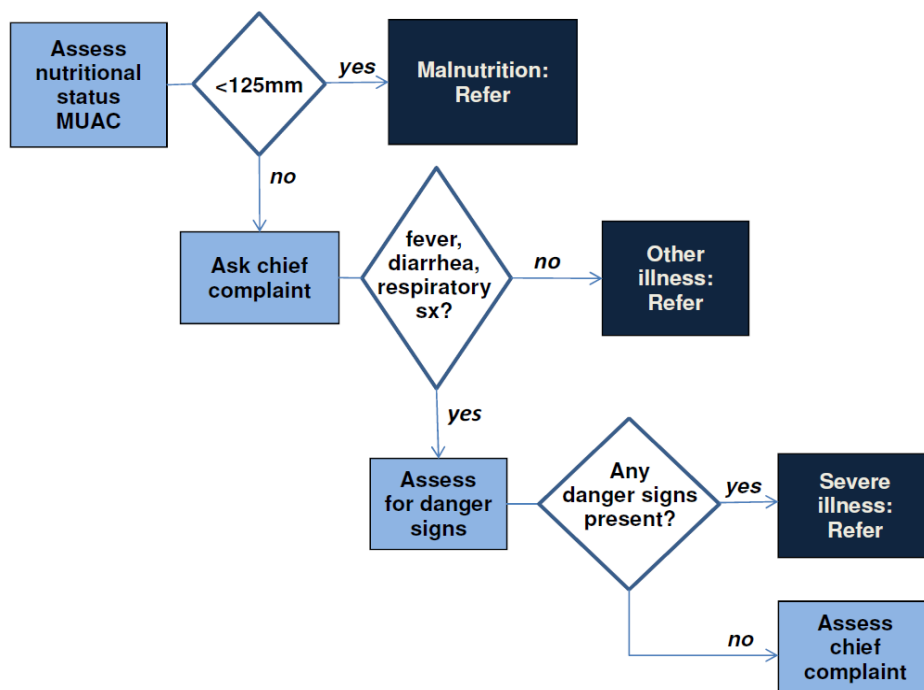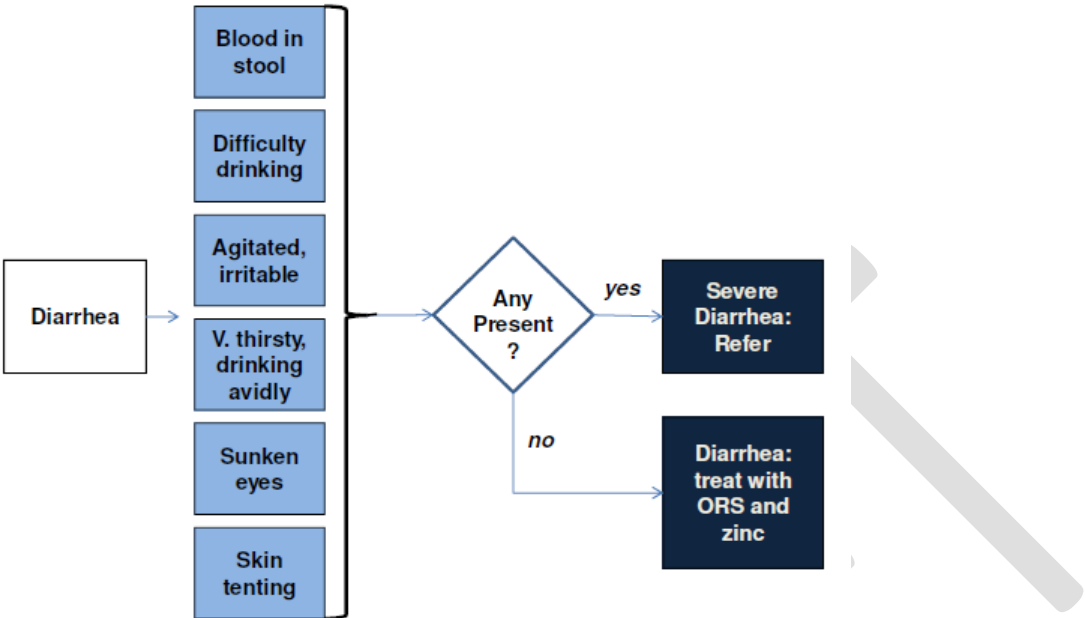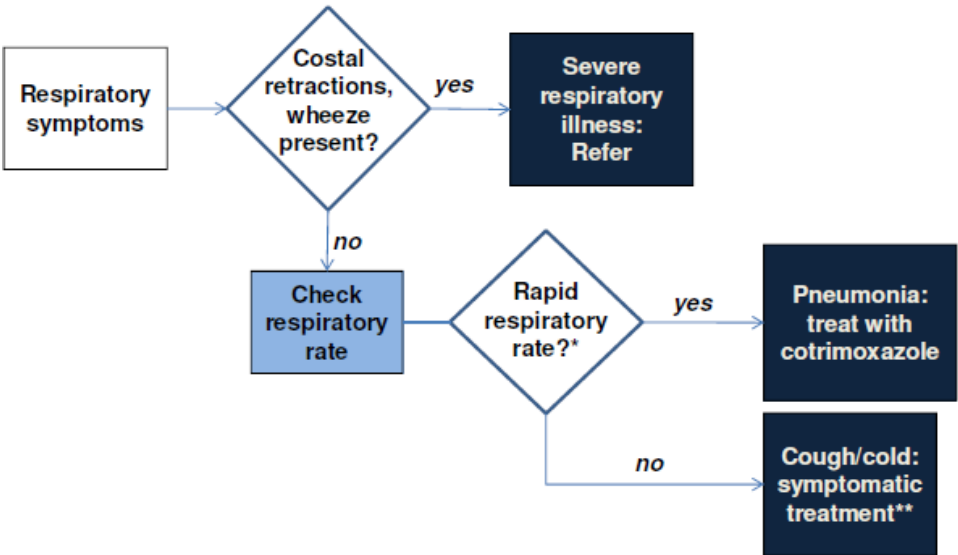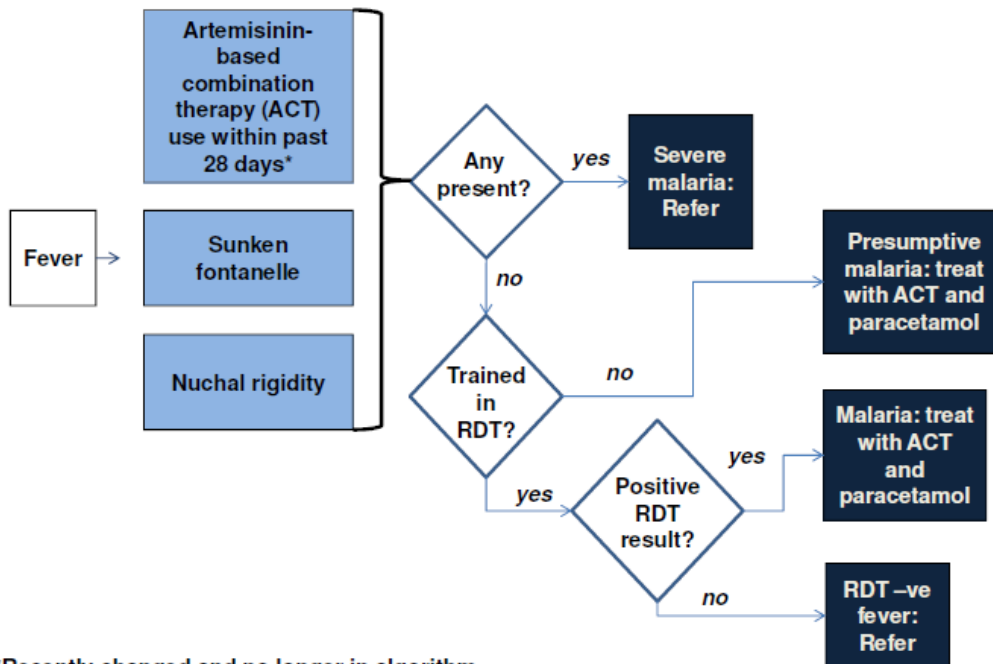


```
                    ┌──────────────────┐
                    │  Artemisinin-    │
                    │     based        │
                    │  combination     │
                    │ therapy (ACT)    │                  Severe
                    │ use within past  │        yes       malaria:
                    │    28 days*      │                   Refer
                    └──────────────────┘        Any
  ┌───────┐         ┌──────────────────┐      present?
  │ Fever │ ──►     │     Sunken       │                    Presumptive
  └───────┘         │   fontanelle     │         no         malaria: treat
                    └──────────────────┘                    with ACT and
                    ┌──────────────────┐      Trained       paracetamol
                    │ Nuchal rigidity  │         in         no
                    └──────────────────┘       RDT?
                                                            Malaria: treat
                                                yes   yes    with ACT
                                               Positive        and
                                                 RDT        paracetamol
                                               result?
                                                            RDT –ve
                                                 no          fever:
                                                             Refer
```

*Recently changed and no longer in algorithm

118

Figure B1. Questions required for the assessment of pregnancy by RH/FP CHVs in Madagascar

Did you experience a miscarriage or abortion within the last seven days?
Are you currently breastfeeding a baby who is less than six months old and not yet experienced a menstrual cycle?
Did you deliver within the last four weeks?
Have you abstained from sexual intercourse since your last period or the delivery date?
Have you regularly and appropriately used contraceptives?

Figure B2. Questions required to assess contraindication to oral contraceptives by RH/FP CHVs in Madagascar

Do you have headaches or severe migraines?
Have you ever been told that you had liver problem, jaundice?
Do you take any drugs currently (Gardenal, Rifampicine, traditional or medical prescription?
Do you smoke cigarettes or any other kind of tobacco?
Have you ever been told you had goiter?
Do you have chest pain?
Do you have dyspnea?
Do you have breast problems or breast cancer?
Do you have bleeding between periods, or bleeding after sexual intercourse?
Have you ever been told that you have high blood pressure?
Did you have edema in your feet during pregnancy?
Do you have varicose veins?
Do you currently breastfeed a baby less than 6 months old?

Figure B3. Questions required to assess contraindication to depot medroxyprogesterone acetate (DMPA) by RH/FP CHVs in Madagascar

Did you have breast cancer or breast problems?
Have you ever had a heart attack or stroke, or do you currently have a blood clot in your legs or lungs?
Have you ever been told you had a liver problem or jaundice?
Have you ever been told you had diabetes?
Have you ever been told you had high blood pressure?
Do you have bleeding between periods or bleeding after sexual intercourse?
Are you currently breastfeeding a baby less than six weeks old?